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The Plant Disease Reporter is issued as a service to plant pathologists throughout the United States. It contains reports, summaries, observations, and comments submitted voluntarily by qualified observers. These reports often are in the form of suggestions, queries, and opinions, frequently purely tentative, offered for consideration or discussion rather than as matters of established fact. In accepting and publishing this material the Plant Disease Epidemics and Identification Section serves merely as an informational clearing house. It does not assume responsibility for the subject matter.

THE PLANT DISEASE REPORTER

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PLANT DISEASE EPIDEMICS AND IDENTIFICATION SECTION

Horticultural Crops Research Branch — Plant Industry Station, Beltsville, Maryland
Volume 40 — May 15, 1956 — Number 5

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THE INCIDENCE OF ROOT DISEASE FUNGI IN WHEAT FIELDS OF CENTRAL AND NORTHWESTERN ALBERTA[1]

L. E. Tyner[2]

Summary

Helminthosporium sativum was isolated more frequently than Fusarium culmorum from wheat stubble in central Alberta, whereas F. culmorum was the dominant pathogen in fields of the Peace River area. Differences in relative proportions of the pathogen are probably due to climate and latitude. Soil samples were secured from fields throughout central and northwestern Alberta and were planted to wheat in the greenhouse. It was found that most of the soil samples contained root pathogens. Infection was in general high and indicative of the significant toll exacted from cereal crops by root diseases.

Common root rot of cereals is present in all parts of Western Canada. Helminthosporium sativum Pamm., King, & Bakke is the most important pathogen involved. Several species of the genus Fusarium are also significant and of these F. culmorum (W. G. Smith) Sacc. is highly pathogenic on the roots of cereal seedlings. The annual plant disease survey of this laboratory encompasses an area from Drumheller in east-central Alberta to Fort St. John in the British Columbia section of the Peace River drainage basin. The soil types represented are light brown, dark brown, black, gray wooded, and transition soils. Precipitation varies roughly within the limits of 16 to 18 inches annually. The lower precipitation is recorded in the eastern and northwestern regions but in the latter the evaporation rate is low and this effects an important compensation. Most of the better-class lands in central Alberta have been cropped for a half century, whereas settlement in the Peace River district began about about 1915 and is still in progress. The areas under consideration afford potentially wide variability in soils, day length, and ecology, and it is of interest to determine whether these factors affect the incidence of root disease pathogens.

Many aspects of the cereal root disease problem have been investigated and Simmonds (3) in 1939 published a review of the work in Western Canada and the United States to that time. Broadfoot (1) made an extensive study of the prevalence of the wheat root pathogens H. sativum and Fusarium spp. as influenced by climate, cultural practice, and crop sequence at various stations in the three Prairie Provinces. He found differences in the relative numbers of pathogens from year to year at any one station and among stations in the same year, but there was no consistent pattern evident. He concluded that environmental factors associated with climatic changes and location had greater influence on the number of fungi than rotation or other cultural practices. Simmonds, Sallans and Ledingham (4) observed differences in the frequency with which spores of H. sativum were isolated from various fields in Saskatchewan and thought that antibiosis in the surface soil as determined by climate and cultural practice was an important factor affecting the mortality of the spores.

METHODS

Data from the crop disease surveys conducted in August in the years 1951-1955 are considered. The severity of root disease was estimated in the field from an examination of the roots and crown. If both common root rot and take-all appeared to be present an attempt was made to assess the relative damage attributable to each type of infection. Samples of stubble and of soil were taken from representative fields. The soil samples were placed in pots in the greenhouse and disease ratings were made on Thatcher wheat seedlings grown in them. Approximately 50 small pieces of crowns and roots of the stubble from each sample were surface sterilized in 0.1% mercuric chloride solution for 1 minute, placed in a Gooch crucible, rinsed three times with sterile water and placed on potato dextrose agar in seven Petri plates. The number of colonies of H. sativum and F. culmorum that grew from the root sections was recorded.

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RESULTS

The number of isolates of H. sativum and F. culmorum from stubble samples secured during the past 5 years is shown in Table 1. Many genera of fungi were observed growing from the plated sections of root tissue and in a high percentage of cases colonies of H. sativum and F. culmorum were recovered. Few isolates of Ophiobolus graminis (Sacc.) Sacc., the causal agent of take-all, were recorded even where the roots were obviously infected with this pathogen. O. graminis is slow growing, readily masked by other fungi, and even when special techniques are employed is rarely isolated.

Table 1. Isolates of root pathogens from the stubble of wheat fields in central and northwestern Alberta.

Year	Roots plated	Isolates			
		Helminthosporium sativum		Fusarium culmorum	
		Number	Percent	Number	Percent
		Central Alberta			
1951	714	199	27.8	26	3.6
1952	2270	676	29.7	174	7.7
1953	1884	563	29.9	398	21.1
1954	1300	353	27.1	61	4.7
1955	504	123	24.4	92	18.2
		Northwestern Alberta			
1951	546	74	13.5	85	15.6
1952	990	192	19.4	264	26.6
1953	704	118	16.7	174	24.7
1954	1170	55	4.7	369	31.5
1955	840	99	11.8	480	57.1

A significant and consistent pattern of distribution of isolates of H. sativum and F. culmorum was apparent. From fields in central Alberta more isolates of H. sativum were obtained each year than of F. culmorum, whereas stubble from fields in northwestern Alberta yielded many more isolates of F. culmorum than of H. sativum. The cause of the observed difference in distribution of the two pathogens according to region is not known but it is probably related to climatic factors. Because of the difference in latitude the length of day during the growing season in the Peace River area is considerably longer than it is in central Alberta and influences maturing of the crops. For example, Thatcher wheat reaches maturity at Fort Vermilion 26 days earlier than at Lacombe in central Alberta. It is also of interest to record the incidence of cereal pathogens still farther north. Wheat stubble was kindly sent to the laboratory in 1952 by Mr. J. A. Gilbey, Officer in Charge, Experimental Sub-station, Fort Simpson, Northwest Territory, which is approximately 400 miles northwest of the Peace River area. It is at latitude 62° N., which is about the same latitude as that of the experimental station at Palmer, Alaska. Five hundred and forty root sections incubated on potato dextrose agar produced 36 isolates of H. sativum, 150 of F. culmorum and other species of Fusarium, and 140 of Curvularia spicifera (Bainier) Boedijn, a species isolated only rarely from stubble in Alberta.

In the areas considered in the present study 655 and 626 wheat fields were visited in the years 1953 and 1954. Half of the fields showed infection ratings of more than 10 percent, and of these one fifth were rated as about 25 percent infection. Estimations of root disease in the field were made by employing the categories trace, slight, moderate, and severe, which correspond to percentage infection ranges of 0-10, 11-25, 26-40, and over 40, respectively. It may be noted that Sallans (2) found that root disease ratings such as those used herein were related to reductions in yield of about the same magnitude as the percentage of root disease estimated. Samples of soil taken from representative fields were planted to Thatcher wheat

Table 2. Infection on mature wheat in the field and on wheat seedlings in the greenhouse grown in soil from the fields visited.

Infection range, percent	Number of samples			
	Year 1953		Year 1954	
	Field	Greenhouse	Field	Greenhouse
0 - 10	17	4	5	4
11 - 25	12	20	9	24
26 - 40	4	13	20	7
Over 40	6	2	2	1

in the greenhouse and infection on the seedlings was recorded in efforts to determine the prevalence of pathogens in the soils. The data in Table 2 indicate that significant damage to the wheat crop in the fields resulted from root diseases and the greenhouse tests demonstrated that pathogens were actually commonly present in the soil samples, thus confirming the validity of the diagnosis in the field.

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DRYLAND ROOT ROT OF 1954-55 WINTER WHEAT IN EASTERN NEW MEXICO[1]

C. H. Hsi[2]

For the third consecutive year, dryland root rot was widespread in eastern New Mexico in 1955. The disease was found in all major wheat-growing sections and persisted on wheat throughout the growing season. Root rot in 1955 was considerably more severe on wheat than in the previous two seasons. In extreme cases, wheat plants were killed by the disease at early stages of growth. Crown rot was also prevalent in 1955. Intensive bronze or black lesions could be detected easily by splitting or by cross section of the infected wheat crowns. Diseased plants were pulled up readily because they often broke off at the decayed crown. Straw-colored or improperly-filled heads, reduction in plant size, reduction in number of productive tillers, and breaking over of the pre-ripened culms were some of the aerial symptoms associated with root rot in badly-diseased fields.

Conditions which predisposed wheat plants to attack by root rot organisms were 1) favorable moisture in late August, which encouraged the planting of a large percentage of wheat fields at that time or shortly thereafter, when high soil temperatures were conducive to the disease development, 2) fall epidemic of leaf rust (Puccinia rubigo-vera tritici), which considerably weakened the wheat plants, and 3) severe drought, which occurred during most of the growing season (less than 1 inch of total precipitation in the period from October 10, 1954, to April 21, 1955). Pertinent weather data from several representative locations in the major wheat-growing area of eastern New Mexico are given in Tables 1 and 2. Table 1 shows maximum, minimum, average, and extreme temperatures for the planting months August and September, 1954. Table 2 shows monthly precipitation totals from July, 1954, through June, 1955, and annual totals for 12 months preceding this period.

Table 1. The maximum, minimum, average, highest, and lowest temperatures recorded at four weather stations in eastern New Mexico for the wheat-planting months August and September, 1954.

Weather Stations	1954 Temperatures (° F.)									
	August					September				
	Average Maximum	Average Minimum	Average	Highest	Lowest	Average Maximum	Average Minimum	Average	Highest	Lowest
Cameron	89.7	62.6	76.2	98	58	86.9	55.9	71.4	95	41
Clovis	90.1	63.7	76.9	98	56	86.4	57.4	71.9	95	46
Plains Substation	89.0	62.7	75.9	97	59	86.3	56.8	71.6	94	47
Portales	90.6	59.9	75.3	98	53	87.9	55.3	71.6	95	44

[1] Journal Series No. 103, Agricultural Experiment Station, New Mexico College of Agriculture and Mechanic Arts.

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Table 2. Annual precipitation from July, 1953, to June, 1954, and monthly precipitation from July, 1954, to June, 1955, recorded at five weather stations in the New Mexico high plains area.

Weather Stations	Annual Precipitation (inches) July '53 June '54	Monthly Precipitation 1954-55 (inches)											
		July	August	September	October	November	December	January	February	March	April	May	June	Total
Cameron	11.64	3.23	2.03	.25	1.87	.03	T	.07	T	.05	2.21	2.31	1.98	14.03
Clovis	12.53	.50	6.13	.14	3.65	.02	.22	.30	T	.01	.80	2.10	2.66	16.53
Forrest	13.96	2.03	2.76	.34	3.77	.08	.01	.16	.00	.08	1.84	1.13	1.00	13.20
Plains Substation	11.22	1.13	4.00	.27	2.79	T	.15	.18	.00	.04	.88	1.91	1.68	13.03
Portales	10.22	.94	11.25	.60	2.54	.00	.10	.34	.03	T	.27	2.51	.49	19.07

Table 3. Frequency distribution of surveyed wheat fields of eastern New Mexico in classes of percentage of root rot for October and December, 1954, and March, May, and June, 1955.

Months 1954-55	Number of surveyed wheat fields within classes of percentage of root rot					Actual Mean percentage of root rot
	26-40.9	41-55.9	56-70.9	71-85.9	86-100	
October, 1954	5	10	7	10	3	61.4
December, 1954		1	6	3	1	70.2
March, 1955		1	5	4	15	82.2
May, 1955			2	2	5	83.9
June, 1955				2	12	93.2

Frequent surveys from October 1954, to June 1955, were made in wheat fields in the area. Fields were chosen at random. Several miles generally separated any two fields. In each field, 30 to 60 plants were taken at random from five or more places spaced at appropriate distance. Percentage of root rot in each field was estimated by dividing the total number of root-rot-infected plants in each field collection by the total number of plants of that collection. Table 3 shows the frequency distribution of the wheat fields in various classes according to the percentage of root rot for each of the months surveyed. On the bases of the frequency dis-

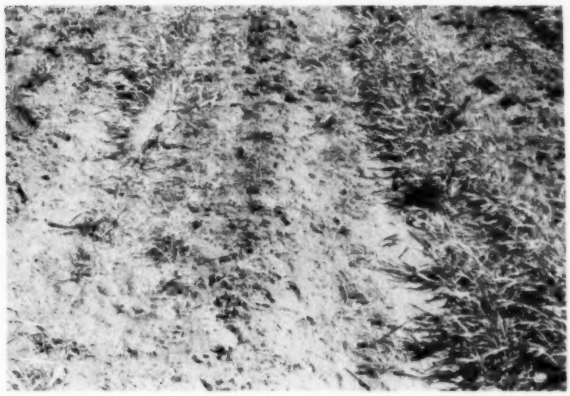

FIGURE 1. Severe injury and killing of young wheat plants caused by root rot infection. Plants at right escaped the disease.

Table 4. Fungi isolated from wheat samples affected with root rot in eastern New Mexico during the period from October, 1954, to June, 1955.

Fungus	Number of fields from which fungus was isolated (1954-55)					
	October	December	March	May	June	Total
Helminthosporium sativum	31[a]/35[b]	9/11	23/25	8/9	11/14	82/94
Rhizoctonia solania	24/35	8/11	23/25	5/9	11/14	71/94
Curvularia spp.	4/35	9/11	13/25	4/9	6/14	36/94
Fusarium spp.	2/35	3/11	4/25	2/9	5/14	16/94
Total	61/35	29/11	63/25	19/9	33/14	205/94

[a] Number of fields from which fungus was isolated.
[b] Actual number of fields surveyed.

tribution and of the mean percentage of root rot, severity of the disease apparently kept pace with the 1954-55 wheat-growing season.

Root rot organisms commonly isolated from the diseased plants in the area included Helminthosporium sativum, Rhizoctonia solani, Fusarium spp., and Curvularia spp. Table 4 gives the relative frequency of isolation of these fungi for the months October and December, 1954, and March, May, and June, 1955. On the basis of total frequency of isolation in 1955, the root rot organisms ranked as follows: H. sativum, 82 times; R. solani, 71 times; Curvularia spp., 36 times; and Fusarium spp., 16 times. As in preceding years, physiologic specialization occurred in all root rot organisms isolated in 1955.

NEW MEXICO AGRICULTURAL EXPERIMENT STATION, PLAINS SUBSTATION

EFFECTIVENESS OF VARIOUS SEED TREATMENT MATERIALS WHEN APPLIED TO OATS WITH COMMERCIAL TREATING MACHINES

D. C. Arny

Summary

It appears from these limited tests that comparisons of organic mercury seed treatment materials on the basis of machine treatment are not essentially different from comparisons made with laboratory treatment. However, du Pont 365 compared less favorably with the standards, Ceresan M and Panogen, under machine treatment than with hand treatment. Seed treatment materials with intermediate effectiveness may give better disease control under laboratory treatment than under commercial procedures.

The effectiveness of various seed treatment materials with machine application was tested using seed of Vicland oats treated in the Panogen (direct) treater or the Gustafson slurry treater. The seed (1954 crop) was very heavily infected with Helminthosporium victoriae Meehan & Murphy under natural conditions. The treating was done in late April 1955. The manufacturers' directions were followed in adjusting the machines and in diluting the materials

Table 1. Effect of machine application of several seed treatment materials on the seedling blight (Helminthosporium victoriae) of Vicland oats. Seed stored for various intervals before planting in soil in greenhouse. Wisconsin, spring 1955.

Treatment			Per cent blight after storage of:					
Material[a]	Method	Oz./bu.	1 day	2 days	4 days	8 days	18 days	Ave.
Panogen 15	direct	3/4	12[b]	15	12	14	4	11.4
Ceresan M2 X	slurry	1/4	17	21	12	10	4	12.9
Panogen 42	slurry	1/4	9	18	17	17	6	13.3
Du Pont 244	direct	3/4	23	24	22	18	7	18.5
MEMA	slurry	1/4	27	29	25	27	6	22.8
Du Pont 365	slurry	1/2	23	32	34	38	18	28.9
Setrete	slurry	1/2	43	48	55	46	30	44.2
Setrete	direct	1/2	48	54	50	55	33	47.9
Merculine	slurry	1/2	50	59	61	61	34	53.1
None	-	-	59	57	62	63	59	63.9
L.S.D. 5%	-	-	12	12	13	14	6	5.1

[a]Active ingredients are as follows: Panogen 15 -- 2.2% cyano(methylmercuri) guanidine; Ceresan M 2X -- 7.7% N-(ethylmercuri)-p-toluenesulfonanilide; Panogen 42 -- 6.3% cyano(methylmercuri)guanidine; DuPont 244 -- 2.27% phenylmercury acetate+1.57% ethylmercury acetate; MEMA -- 11.4% 2-methoxyethylmercury acetate; DuPont 365 -- 3.39% phenylmercury acetate+2.35% ethylmercury acetate; Setrete -- 7% phenylmercury acetate; Merculine -- 10% phenylmercury salicylate.

[b]Each figure is an average of 3 replications of 100 seeds each.

Table 2. Yields of Vicland oats following seed treatment with several materials in the Panogen direct treater or Gustafson slurry treater. Wisconsin, Summer 1955.

Treatment		Yield in bu. per acre[a]			
		Machine application			Hand application
Material	Method	Hancock	Madison	Average	Madison
Panogen 15	direct	40.2	61.3	50.8	64.0
Ceresan M 2X	slurry	40.2	56.2	48.2	64.5
Du Pont 244	direct	38.1	57.8	48.0	60.4
Panogen 42	slurry	37.7	52.0	44.9	70.8
MEMA	slurry	28.9	55.7	42.3	56.9
Du Pont 365	slurry	32.9	46.0	39.5	62.7
Setrete	direct	31.6	40.3	35.9	-
Setrete	slurry	30.1	38.3	34.2	49.0
Merculine	slurry	28.0	39.0	33.5	47.4
None	—	21.2	32.2	26.7	44.4
L.S.D. 5%		6.8	8.9	5.5	6.8

[a] Each trial consisted of 4 replications of 3 row plots, 18 feet long. Sixteen feet of the center was harvested for yield.

where necessary. Approximately 6 bushels of seed were treated for each material-machine combination. A 2-bushel sample was saved from the middle of the run, and all other seed discarded. After each treatment the machine was thoroughly flushed out with running water. The treated samples were stored in burlap bags in isolated positions. Seed lots for testing were taken from the center of the bags by means of a probe.

Samples for greenhouse tests were taken at 1, 2, 4, 8, and 18 days after treatment. Three replications of 100 kernels each for each treatment and date were planted in soil. Blighted and healthy plants were counted 3 to 4 weeks after planting. Average blight percentages are given in Table 1. The level of disease was high, and even the standard materials, Ceresan M 2X and Panogen 15, allowed the development of some blighted seedlings. Each treatment behaved uniformly over the several storage periods. On the basis of the averages for all storage periods, Ceresan M 2X, Panogen 15, and Panogen 42 gave the best disease control. Du Pont 244 and MEMA gave significantly less control. Du Pont 365 gave poorer control than Du Pont 244 or MEMA. Setrete direct (1 part water: 2 parts Setrete), Setrete slurry, and Merculine gave only limited reductions in blight, and were distinctly inferior to the other materials.

The effects of the machine treatments on yield were determined at two locations, using seed from the same treated lots as in the greenhouse tests. The yield trial at Hancock, on light sandy soil, was planted 4 days after the seed was treated, and the one at Madison, on heavier silt loam, 17 days after treatment. Results are summarized in Table 2. In the analyses of variance the F values for treatment effects were highly significant. On the basis of the averages for both trials the materials behaved in general as would be expected from the seedling blight results. Du Pont 244 showed some improvement in effectiveness, as it resulted

in yields comparable with those given by Ceresan M and Panogen. Du Pont 365 and MEMA were intermediate in their effects on yield. Treatment with Setrete or Merculine resulted in only slight increases in yield as compared to no treatment.

Seed from the same lot was treated in the laboratory and grown in a similar yield trial. Results are shown in Table 2 for comparison. In this test Du Pont 365 compared favorably with the standards, but MEMA gave significantly less yield. Setrete and Merculine gave no real increase in yield over the nontreated.

Vicland oats is no longer grown extensively in Wisconsin because of its susceptibility to Victoria blight. However, for the same reason it is considered to be a good tester for seed treatment materials. The blight organism has appeared to be more difficult to eliminate from the seed than the smut organisms, and thus furnishes a more rigorous test for the materials.

DEPARTMENTS OF AGRONOMY AND PLANT PATHOLOGY, UNIVERSITY OF WISCONSIN, MADISON, WISCONSIN

STEWART'S DISEASE PROSPECTS FOR 1956

G. H. Boewe

In 1956, Stewart's disease or bacterial wilt (Bacterium stewartii E. F. Sm.) of corn probably will occur over the entire State and be destructive much farther north in Illinois than it was in 1955.

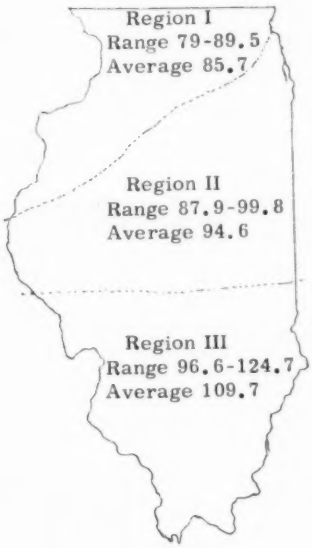

FIGURE 1. Winter temperature index regions in Illinois, winter 1955-1956.

Two principal types of damage to corn are produced by Stewart's disease: an early season wilt and death of plants, especially in sweet corn, and a late season leaf blight, which may be severe enough to cause premature death of plants. The wilt and leaf blight phases of the disease are expected to appear on susceptible corn in Illinois as shown by the table below.

Region	Early season wilt	Late season leaf blight
I	Light	Light to severe
II	Light to severe	Severe
III	Destructive	Severe

The three regions are shown on Figure 1. These regions were determined on the basis of winter-temperature indexes (the sum of the mean temperatures of December, January, and February of the past winter) calculated from the records of 91 weather reporting stations in the State. The data were obtained from the U. S. Weather Bureau Office at Champaign. The range of indexes and an average index are shown for each of the three regions.

As indicating the future occurrence of Stewart's disease, these indexes appear to have significance as follows:

If the index is	Early season wilt probably will be	Late season leaf blight probably will be
100 or more	Destructive	Severe
Between 90 and 100	Light to severe	Severe
Between 80 and 90	Absent or nearly so	Light to severe
Below 80	Absent	A trace at the most

The chief means of overwintering of the Stewart's disease bacteria is in the bodies of adult corn flea beetles. Research conducted in Illinois by entomologists of the Illinois Natural History Survey indicates that dieldrin is very effective in controlling the corn flea beetles. Based upon this work, the following dosages of dieldrin are recommended by them: In areas where corn flea beetles are constantly a problem, apply 1 1/4 to 1 1/2 pounds of actual dieldrin per acre and work into the upper few inches of soil just before or after planting. Where soil treatment was not made, an application of 1/4 pound dieldrin or 1 1/2 pounds of DDT banded over the row, as a foliage spray when the beetles first appear will give some protection. Additional foliage treatments may be necessary if beetle populations persist.

This forecast on Stewart's disease, the eighth to be made for Illinois, is based on the close relationship that appears to exist between the amount of disease that develops during the summer and the temperature of the preceding winter. In general the development of both phases of the disease, especially on susceptible varieties of sweet corn, has coincided closely with the predictions made in the previous forecasts. Recent surveys made by our entomologists over the southern half of the State show that corn flea beetles are present and active in areas sampled. However, it is still possible that some unknown factor or factors may influence the survival of the beetles between now and the time that corn is available for them to attack.

ILLINOIS STATE NATURAL HISTORY SURVEY, URBANA, ILLINOIS

STALK ROTS OF SORGHUM IN EASTERN NEW MEXICO[1]

C. H. Hsi[2]

In the summer of 1955, stalk rots caused considerable damage to the dryland and lightly-irrigated sorghums in eastern New Mexico. The rots were prevalent in all major sorghum-growing sections. They affected various types of sorghums, which included grain sorghum, sweet sorgo, sudan grass, and broomcorn.

The growing season was characterized by favorable soil moisture conditions at early stages of plant growth, followed by a rather long dry spell when the plants were approaching maturity. This combination of environmental conditions was apparently conducive to the development of sorghum stalk rots.

Generally, four types of rots were found in the area, namely charcoal rot, general stalk rot associated with lodging, Colletotrichum stalk rot, and Fusarium stalk rot. The latter two rots were recognized for the first time in New Mexico in 1955.

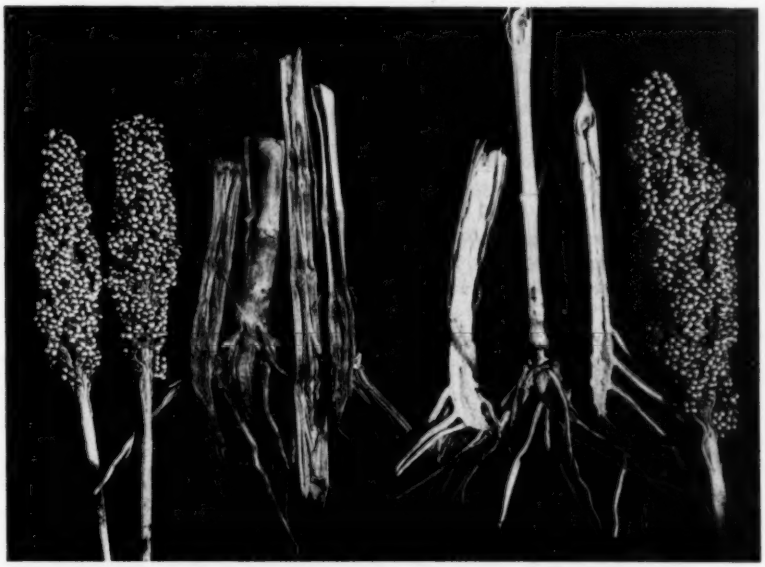

FIGURE 1. Charcoal rot of sorghum. Diseased specimens (left) show underdeveloped heads, with poor yield of grain, and root and stalk rots. Healthy specimens are at the right.

Charcoal Rot: Field symptoms of charcoal rot did not become conspicuous until the plants were reaching maturity. Lodging was usually the first indication of the disease. In severe cases, more than 30 percent of the plants were breaking over at the base in diseased fields. Close examination of the infected plants revealed under-developed heads with poor yield of grain, premature ripening of the stalks, and frequent discoloration on the outside of the basal stalks. Internal symptoms of a plant were evident when a typically diseased stalk was split longitudinally. The pith was found to be badly disintegrated, and the separated vascular bundles were covered with numerous, tiny, charcoal-colored fruiting bodies (sclerotia) of the

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FIGURE 2. Colletotrichum stalk rot of broomcorn. Diseased specimens (left) show poor, prematurely-ripened brush, leaf anthracnose, and root and stalk rots. Healthy specimens are at the right.

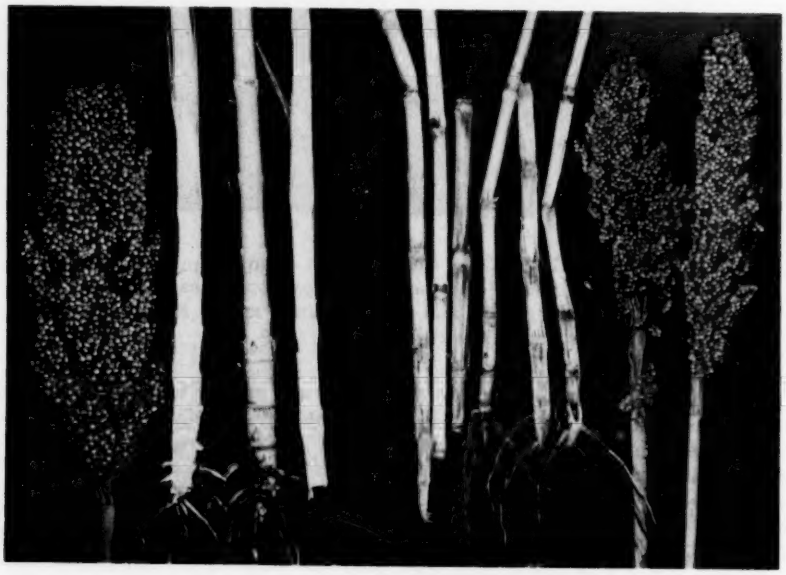

FIGURE 3. Fusarium stalk rot of sorghum. Diseased specimens (right) show small heads with poor yield of grain, root and stalk rots, and node lesions. Healthy specimens are at the left.

fungus Sclerotium bataticola. The contrast between the charcoal-rot-infected and the healthy sorghums can be seen in Figure 1. The picture also shows that the rot can extend for considerable distance up the stalk, as well as down into the root system.

In general, more charcoal rot was found on sorghums grown in sandy soil than in heavy soil. Two things may explain this phenomenon. First, more sorghums are grown in sandy soil than in soils of heavier texture; hence the probability of finding this disease there is greater. Second, sandy soil has less water-holding capacity and is more variable in temperature than either loamy or clay soil, and the combination of deficient soil moisture and high temperatures often favors the development of charcoal rot.

Colletotrichum Stalk Rot: This rot was prevalent on broomcorn and Sudan grass in 1955. Although the disease was identified for the first time, its presence in New Mexico for a number of years was reasonably assured by information gathered from the growers. The last epidemic was believed to have occurred in 1951. This disease was incited mostly by Colletotrichum graminicola and partly by Gloeosporium spp.

In severely infected fields, broomcorn plants ripened prematurely and frequently lodged under the pressure of moderate winds. The brush was often small, of very poor quality, and often dead before fully emerged from the boot. In extreme cases, the entire field was burned up, bringing virtually complete loss to growers.

External symptoms on the diseased plants often consist of leaf anthracnose and discolored lesions on the outside of the basal stalks. Internal symptoms vary from complete discoloration and decay to partial decay of the basal portions of the stalks, depending upon different stages or degrees of infection.

Figure 2 shows the contrast between diseased and healthy broomcorn. Diseased broomcorns are characterized by poor prematurely ripened brush, leaf anthracnose, and stalk rot.

Fusarium Stalk Rot: This rot caused severe lodging in small confined areas of two sorghum fields, one dryland and the other irrigated. The causal fungus of this disease, Fusarium moniliforme, is constantly present in the soil and invades the sorghum plants only through openings made by insects, mechanical injuries, or other agencies.

The symptoms of this disease are represented by small heads with poor yield of grain, root and stalk rots, and node lesions (Figure 3).

General Stalk Rot Associated With Lodging: Lodging of sorghum was general over the area. The point of breaking over was anywhere between the ground level and the base of the peduncle. Poorly developed heads and premature ripening usually accompanied lodging. The inside of lodged stalks often showed watersoaked or discolored pith in varying degrees of disintegration. Bacteria, Rhizoctonia solani, Fusarium spp., Helminthosporium spp., Alternaria spp., and Penicillium spp. were isolated from lodged stalks.

NEW MEXICO AGRICULTURAL EXPERIMENT STATION, PLAINS SUBSTATION

AN OUTBREAK OF PIRICULARIA ON RICE IN 1955

John G. Atkins[1]

In recent years the old rice disease caused by Piricularia oryzae Cav., commonly known as Piricularia, blast, or rotten neck, had all but disappeared in the Gulf Coast rice area. Consequently, it has been considered as a very minor rice disease in those States. In 1955, however, it reappeared with sufficient severity as to alarm the growers and county agents, particularly in Acadia Parish in Louisiana. The fields affected were Magnolia or Zenith. An article concerning the blast outbreak appeared in the Rice Journal[2].

The 1955 outbreak of Piricularia is being reported to emphasize again the potential damage from this sporadic rice disease and certain of its interesting aspects. Piricularia appeared in late July and early August on rice sown in June. It was confined to fields of young rice in the mid-tillering stage and was not observed on rice sown in April or May. Rice in this stage of growth is very susceptible, as has been pointed out in the literature. Although most of the fields showed only light damage a few showed up to an estimated 20 percent defoliation, with nearly 100 percent defoliation in spots or areas within a field.

The disease presumably became established and developed during July when environmental conditions were favorable for development. The weather during July was hot, humid, and rainy as indicated by Table 1. Nightly dews along with numerous rains or showers, particularly light afternoon showers, and cloudy weather served to keep the rice leaves wet a good part of each day and night. It is well known that such conditions are nearly ideal for the production of conidia on diseased plants and development of the disease.

Table 1. Summary of weather observations for July 1955.

	Beaumont, Texas	Crowley, La.
Total rainfall, inches	4.7	11.0
Number days with rain	15	13
Number days with dew	30	-
Mean relative humidity	91.8%	-
Mean maximum temperature	91.9°F.	88.3°F.
Mean minimum temperature	72.3°F.	72.4°F.

With a change in weather conditions in August the disease did not spread or develop further and the new growth of diseased plants remained healthy or nearly so. It is probable that grain yields were not reduced appreciably except in spots where stands were seriously reduced.

At the Rice-Pasture Experiment Station, Beaumont, Texas, blast was prevalent throughout a replicated variety-fertilizer test sown in June. Conspicuous differences in the amount of leaf infection were observed between fertilizer treatments and between varieties with identical fertilizer treatments. The differences are reflected in the readings given in Table 2. CI 8970 was definitely more susceptible than selection B4512A1-32 (CI 9122). The plots receiving no nitrogen showed considerably less infection than those with nitrogen. Potassium had no effect upon the amount of foliar infection. Rice is known to be more susceptible to this fungus in soils with high nitrogen derived from either commercial fertilizers or natural accumulation of organic matter. Of the fields observed in Louisiana, Piricularia was most severe in a field that had been in pasture for perhaps 20 years. Blast has frequently been reported to be more serious on first-year rice land.

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[2] Anon. Blast hits June seeded rice in Louisiana. Rice Journal 58 (10): 41. 1955.

Table 2. Piricularia readings[a] from a variety-fertilizer test at the Rice-Pasture Experiment Station, Beaumont, Texas.

	Variety	
Treatment	CI 8970	B4512A1-32
160-40-0	2.8	0.4
160-40-40	2.5	0.4
120-40-0	2.3	0.4
120-40-40	2.4	0.5
80-40-0	2.4	0.3
80-40-40	2.5	0.3
0-0-0	0.4	0.1

[a] Average rating based on infection classes 1 to 5. Trace readings averaged as 0.5.

Although the 1955 Piricularia outbreak was not serious from the standpoint of general yield reduction, the potentialities of the disease were again demonstrated. The importance of determining varietal reaction to the disease cannot be overlooked. Such differences are clearly indicated by this test. Observations made in 1955 are reported to emphasize again two interesting aspects of the disease: 1) necessity of favorable environmental conditions, and 2) susceptibility as related to age of plants and increased susceptibility due to high nitrogen. Observations indicate that while losses from some of the other foliage diseases of rice, such as white tip (Aphelenchoides oryzae) and the leaf spots caused by Cercospora oryzae and Helminthosporium oryzae, are alleviated by good or recommended cultural practices including fairly high nitrogen fertilization and long term rotations, Piricularia behaves in the opposite manner.

Although rice plants in the heading stage of growth are also known to be susceptible, rotten neck symptoms were not observed, except at Beaumont on CI 8970 and on a few rather susceptible introductions from the World Rice Collection.

FIELDS CROPS RESEARCH BRANCH, AGRICULTURAL RESEARCH SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATING WITH THE TEXAS AND LOUISIANA AGRICULTURAL EXPERIMENT STATIONS

FUNGI ASSOCIATED WITH UNBLEMISHED SPANISH PEANUTS IN TEXAS

Don C. Norton, S. K. Menon, and A. L. Flangas

Abstract

Plating of surface-sterilized unblemished Spanish peanuts on a nutrient medium revealed an average of 22.2 percent of invasion by fungi over a 6-week period before harvest. The average amount of invasion in post-harvest samplings was 27.4 percent. Aspergillus flavus, Alternaria spp., and Fusarium spp. were the most common fungi isolated.

Discoloration of Spanish peanuts is especially apparent during grading and following storage. At Federal inspection stations, a nut must have 25 percent of its surface area discolored before it goes into the damaged group. The over-all damage at grading in Texas is often about 2 percent but losses up to 6 percent and even more are not uncommon.

It was speculated that much of this damage might originate from invasion by fungi occurring in the field. Experiments were devised to determine the extent of invasion of Spanish peanuts by fungi in Texas at different stages of development and in storage.

Six weeks before harvest, 1004 fruits were picked from randomly selected plants, growing at the main station farm at College Station during 1952. The external appearance of the fruits is summarized in Table 1. One-hundred-sixty-eight shells with no discoloration were surface-sterilized for 3 minutes with 1:100 bichloride of mercury, rinsed in sterile water, and plated on a nutrient medium. Fungi grew from 94.1 percent of the shells. Aspergillus flavus Link and A. niger van Tieghem were most common.

In another experiment 100 unblemished nuts taken from fruits with no discoloration or visible damage to the shells were sampled at intervals over a 6-week period before harvest, surface-sterilized and plated. The results are presented in Table 2. Of the 111 nuts from which fungi grew, 79.3 percent contained A. flavus. A similar study of pre-harvest invasion of nuts grown at Stephenville, Texas, gave comparable results except that A. niger instead of A. flavus was the dominant fungus involved.

Table 1. External appearance of Spanish peanut fruits picked at random on September 19, 1952, 6 weeks prior to harvest.

External appearance of fruit	Number of fruits	Percent of total fruits collected
Fungus mat	3	0.3
50-100 percent discoloration	64	6.4
1-50 percent discoloration	250	24.8
No discoloration or breaks in fruit	667	66.6
No discoloration but with breaks in fruit	20	1.9

A post-harvest experiment was conducted during the 1953-1954 season to measure the amount of colonization occurring in stored peanuts. Of 1,785 unblemished stored nuts plated, 489 or 27.4 percent contained fungi.

A summary of the total number of unblemished nuts plated on nutrient media during 1952-1955 is presented in Table 3.

In some of the southeastern States, a concealed damage of runner peanuts is common in which discoloration or a fungus mat growing between the halves of apparently healthy peanut seeds is noticeable (1). Although hundreds of unblemished nuts of the Spanish type were examined specifically for this type of damage in Texas, none was found. Little internal discolor-

Table 2. Isolations obtained from unblemished nuts prior to harvest.

Date Sampled	Total Nuts Plated	Number from which fungi grew	Percent from which fungi grew
9-26-52	100	11	11
10-3-52	100	29	29
10-10-52	100	54	54
10-17-52	100	8	8
10-31-52	100	9	9
Total	500	111	22.2

Table 3. Summary of total platings of unblemished Spanish peanuts, 1952-1955.

Total platings	2,780
Total from which fungi grew	701
Percent from which fungi grew	25.2

Fungus	Total number	Percent of total isolates
Aspergillus flavus Link	174	24.7
Alternaria spp.	89	12.6
Fusarium spp.	76	10.8
Rhizopus nigricans Ehrenberg	63	8.9
Rhizoctonia spp.	57	8.1
Penicillium spp.	55	7.8
Aspergillus niger van Tieghem	51	7.2
Macrophomina phaseoli (Maubl.) Ashby	17	2.4
Helminthosporium sp.	6	0.9
Aspergillus terreus Thom	5	0.7
Sclerotium rolfsii Sacc.	4	0.6
Mucor sp.	3	0.4
Trichoderma viride Pers. ex. Fr.	3	0.4
Aspergillus flavipes (Bain & Sart.) Thom & Church	2	0.3
Curvularia lunata (Wakker) Boedijn	2	0.3
Hormodendrum sp.	1	0.1
Unidentified	97	13.7
Total	705	100.0

ation was noted. Examination of open-face halves of the nuts under a microscope often revealed mycelial strands, but not in a mat type of growth. Undoubtedly, much of the fungus growth obtained from unblemished nuts originates from these mycelial strands.

Heiberg and Ramsey (2) report that damage to shelled peanuts received at the Chicago market represents concealed damage overlooked during processing and grading. Probably, much of this "concealed damage" was of a microscopic nature.

ACKNOWLEDGEMENTS

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DEPARTMENT OF PLANT PHYSIOLOGY AND PATHOLOGY, TEXAS AGRICULTURAL EXPERIMENT STATION, COLLEGE STATION, TEXAS

PLEOSPORA HERBARUM AND PLEOSPHAERULINA HYALOSPORA, TWO PATHOGENIC ASCOMYCETES OF FORAGE LEGUMES[1]

J. L. Allison, G. A. Hemerick and R. R. Nelson[2]

ABSTRACT

Two ascomycetes were isolated by means of ascospore discharge from sclerotoid ascocarps occurring on the overwintered dead stems of alfalfa (Medicago sativa L.) and stolons of white clover (Trifolium repens L.) in North Carolina. One was identified as Pleospora herbarum (Pers.) Rab. (Stemphylium botryosum Wallr.), the causal agent of a common summer leafspot on alfalfa. The second was identified as Pleosphaerulina hyalospora (Ell. & Ev.) Berl. This fungus is a common spring leaf and petiole pathogen on white clover and to a lesser extent on alfalfa. The literature dealing with this fungus is extremely confused and further work on the nomenclature of it and similar fungi remains to be done. However, at the present time the binomial Pleosphaerulina hyalospora is considered to have priority.

Two ascomycetes were isolated by means of ascospore discharge from sclerotoid ascocarps occurring on the overwintered dead stems of alfalfa (Medicago sativa L.) and stolons of common white and Ladino clover (Trifolium repens L.) in North Carolina. One was identified as Pleospora herbarum (Pers.) Rab. (Stemphylium botryosum Wallr.), the causal agent of a common summer leafspot on alfalfa.

The other was not so easily identified. Isolates in culture appeared to be morphologically similar to if not identical with the fungus we had been calling Pseudoplea trifolii (Rostr.) Petr., which is a very common spring leaf and petiole pathogen on common and Ladino white clovers. It also appeared to be morphologically similar to if not identical with the fungus we had been calling Pseudoplea briosiana (Poll.) Hoehn., which is a common spring leaf pathogen on alfalfa. A review of the literature was made and experiments were conducted to aid in the identification of this fungus.

Ellis and Everhart (2) 1890 described Pleospora hyalospora on Lathyrus sativus L. (likely Vicia sativa L.). In 1892 (3) they renamed the species P. americana and added a clover (Trifolium sp.) as a host. Saccardo (12) 1895 placed P. americana in the genus Catharinia and named it Catharinia americana (Ell. & Ev.) Sacc. Berlese (1) 1897 (Sacc. (12) 1899) found P. hyalospora-P. americana Ell. & Ev. different from P. hyalospora Speg. and placed it in the genus Pleosphaerulina under the name Pleosphaerulina hyalospora (Ell. & Ev.) Berl. Rostrup (11) 1899 described Sphaerulina trifolii on T. repens. Pollacci (10) 1902 described Pleosphaerulina briosiana on Medicago falcata L. and M. sativa. Schwarze (13) 1917 described Pleospora hyalospora Ell. & Ev. on M. sativa, and also associated an Alternaria type conidial stage with it. Von Hoehnel (14) 1918 established a new genus Pseudoplea on Pleosphaerulina briosiana and renamed it Pseudoplea briosiana. Petrak (7) 1921 created the binomial Pseudoplea trifolii and reduced Sphaerulina trifolii, Pleosphaerulina briosiana, P. briosiana var. brasiliensis Puttem., and Pseudoplea briosiana to synonymy. In 1927 (8) he changed Pseudoplea trifolii to Pleospora trifolii (Rostr.) Petr. and in 1940 (9) added Saccothecium trifolii (Rostr.) Kirsch. as a synonm of it. Horsfall (5) 1929 retained the binomial Pseudoplea trifolii and added P. medicaginis Miles to its synonymy. Müller (6) 1951 continued the use of the binomial Pseudoplea trifolii and considered Saccothecium trifolii a synonym of it. Weiss and O'Brien (15) 1952, recognizing the confusion in nomenclature, listed the following as occurring in the United States: Pleosphaerulina hyalospora on Medicago sativa and Vicia sativa; Pseudoplea briosiana on Lespedeza cuneata (Dum.) Don and M. sativa; Pseudoplea medicaginis on M. arabica L. and M. lupulina L.; and Pseudoplea trifolii on Trifolium agrarium L., T. carolinianum Michx., T. hybridum L., T. incarnatum L., T. pratense L., and T. repens.

Small pieces of field specimens from overwintered dead stems of alfalfa and stolons of Ladino clover and from naturally infected living leaves of these hosts were attached to the inner

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[1] Cooperative investigations of the Field Crops Research Branch, Agricultural Research Service, United States Department of Agriculture and the North Carolina Agricultural Experiment Station.

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surface of Petri plate covers and placed over plate bottoms containing potato dextrose agar. Plates were maintained at 65° to 75° F. Covers were rotated occasionally to aid in the distribution of discharging ascospores. Monoascospore isolates obtained were transferred to sterile plates and tubes of potato dextrose agar for study. All isolates irrespective of their original source appeared much the same in growth habit producing characteristic black colonies of stromatic texture. Maturation of ascocarps and discharge of ascospores was normally slow but could be hastened by the following technique. After a colony had grown for a week or more it was sliced from the surface of the agar medium and placed agar surface down on a sterile wet filter paper inside the cover of a Petri plate. The cover was then replaced on a plate bottom containing potato dextrose agar. Ascospores usually matured and were discharged within 24 to 36 hours at room temperature. Ascospores usually had 1 medial septum when discharged but later developed 3 transverse septa (rarely more) and 1 longitudinal septum (rarely more). Ascospores were hyaline when discharged and would remain so until germination or until exposure to light. Degree of darkening appeared to be dependent upon amount and intensity of light. Stemphylium-type conidia were produced very sparingly by all isolates.

Greenhouse inoculation experiments were conducted at 65° to 75° F. Cultures from each source prepared for ascospore discharge by the technique described were suspended by means of wire racks above 1-month-old seedling plants of Medicago sativa, Trifolium incarnatum, T. pratense, T. repens (common and Ladino), and Vicia sativa growing in 4-inch clay pots. The foliage was moistened with water and each pot with suspended plate was covered with a polyethylene bag. Bags and plates were removed after 48 hours by which time initial infection lesions were visible. Lesions on all hosts were similar in size and number and ascocarps developed in all lesions within 10 to 12 days.

The fungus dealt with in this study occurs as a parasite on the living leaves and petioles of Medicago sativa and Trifolium repens and as a saprophyte upon overwintered dead debris of the same legumes. It has small ascocarps with thin, light brown, parenchymatic walls which are usually sunken in the leaf tissue and has a rather well developed ostiolar beak. The asci are broad-clavate to saccate, narrowed above with a double wall consisting of a thin outer membrane and an inner gelatinous layer. The ascospores are oblong-ellipsoid, with 3 to 4 transverse septa and 1 to 2 longitudinal septa, hyaline at first but becoming brown on exposure to light.

This fungus has been described in the genera Pleospora, Pleosphaerulina, Sphaerulina, and Pseudoplea. Further work on the taxonomy of this and similar fungi remains to be done. However, at the present time it is placed in the genus Pleosphaerulina and the binomial Pleosphaerulina hyalospora (Ell. & Ev.) Berl. 1897 has priority. The following are provisionally placed in synonymy:

Pleospora hyalospora Ell. & Ev.	1890	
Pleospora americana Ell. & Ev.	1892	
Catharinia americana (Ell. & Ev.) Sacc.	1895	
Sphaerulina trifolii Rostr.	1899	
Pleosphaerulina briosiana Poll.	1902	
Pleosphaerulina briosiana var. brasiliensis (Poll.) Puttem.	1905	
Pseudoplea briosiana (Poll.) Hoehn.	1918	
Pseudoplea trifolii (Rostr.) Petr.	1921	
Pseudoplea medicaginis Miles	1925	
Pleospora trifolii (Rostr.) Petr.	1927	
Saccothecium trifolii (Rostr.) Kirsch.	1938	
Pleosphaerulina briosiana var. macrospora (Poll.) DaCamara	1941	(4)

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IMPORTANT DISEASES OF ALFALFA IN SOUTHERN CALIFORNIA[1]

Donald C. Erwin[2]

SUMMARY

Colletotrichum trifolii Bain & Essary, which causes anthracnose on stems and crowns of alfalfa, has been found for the first time in three southern California counties. Pathogenicity tests proving the causal nature of the fungus are described. Optimum temperature for growth is 24°-27° C. Phytophthora root rot also has been noted in the Imperial Valley for the first time. Incidence of bacterial wilt is increasing in southern California and the disease is reported for the first time in Imperial County. Incidence of the dwarf disease has decreased during the past three years. Rhizoctonia root canker, for which no control is known, is a serious disease in the irrigated desert valleys. Scald was shown to be due to the associated effects of soil moisture and high temperature. The practice of reseeding in damaged stands each fall following scald or Rhizoctonia root canker is a common practice in the Imperial Valley.

INTRODUCTION

Since 1953, numerous surveys of the diseases of alfalfa in the southern California area have revealed the presence of certain diseases not previously reported from some sections of the area. These are anthracnose, Phytophthora root rot, and bacterial wilt, which are discussed below, and a minor occurrence of Stagonospora crown rot in the Imperial Valley, which is caused by Stagonospora meliloti (Lasch) Petr. and is not discussed further. The incidence of dwarf, Rhizoctonia root canker, and scald (a disease associated with excessive irrigation during periods of high temperature) is also discussed.

ANTHRACNOSE OF ALFALFA

A field of alfalfa in which numerous plants were damaged by a disease affecting the stems was noted in Orange County in August of 1953. Black irregularly shaped spots occurred on the lower parts of stems. In advanced stages of the disease these spots became bleached in the center, and acervuli of the causal fungus were formed. Many plants in the field were also affected by a crown rot. The rotted tissue on crowns was yellow to tan in color, and a narrow band of reddish-brown tissue could often be seen on the extremity of the advancing lesion. A fungus that appeared to be Colletotrichum trifolii Bain & Essary was isolated consistently from the margins of the rotted tissue. The symptoms were similar to those described by Monteith (6) for anthracnose of alfalfa, caused by C. trifolii.

Anthracnose of alfalfa was also found in Santa Barbara County in 1954 and in Imperial County in 1955. C. trifolii was again isolated from diseased plants. Identifications of the causal fungus were kindly confirmed by Dr. Joseph C. Gilman of the Department of Botany, Iowa State College, Ames, Iowa.

Pathogenicity tests were conducted in the greenhouse on Africa plants about 2 months old, growing in steam-sterilized soil. A mycelial suspension was prepared by blending one plate of fungus on potato dextrose agar with 250 ml water. Plants were inoculated by 1) dipping roots and crowns in the mycelial suspension, or 2) pouring the mycelial suspension over unwounded crowns, 20 plants being inoculated by each method. Within 3 weeks all the inoculated plants were wilting and showing typical symptoms on roots and crowns. Control plants were not affected. The fungus was also pathogenic to seedlings. In one test four pots were infested with 50 ml of a mycelial suspension and two pots not infested. In the infested soil only 20 percent of the alfalfa seeds emerged as compared to 80 percent emergence in the non-infested. All those plants that emerged from infested soil were weak and yellow in color. These tests were repeated with similar results.

Since Lima beans are an important crop in rotation with alfalfa in both Orange and Santa

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[1] Paper No. 889, University of California Citrus Experiment Station, Riverside, California.

[2] Assistant Plant Pathologist, University of California Citrus Experiment Station, Riverside, California.

Barbara Counties, 5 seeds of Fordhook Concentrated variety were planted in each of 4 pots, and a mycelial and spore suspension of C. trifolii from alfalfa was poured over the seeds in the soil. The fungus caused no reduction in percentage of emergence, and bean plants growing in infested soil showed no symptoms of disease.

Some variation in pathogenicity of the fungus to alfalfa was noted. In old cultures, each derived from a single spore, a white mycelial type arose, and subsequent transfers failed to fruit. Pathogenicity tests with the white mycelial type showed that it was nonpathogenic.

Optimum temperature range for growth of the Orange and Santa Barbara County isolates of the fungus on potato-dextrose agar plates was 24°-27° C. The fungus grew slowly at 8° and 33° C. These temperature data are similar to those reported by Monteith (6) for C. trifolii.

This is, to the writer's knowledge, the first report of anthracnose on alfalfa in California. It is not yet a serious problem since it does not seem to be widely distributed. The crown rot caused by this disease appears to be more important than the stem injury, although in three fields much stem breakage was noted as the result of anthracnose on the stems.

PHYTOPHTHORA ROOT ROT

The occurrence and cause of this disease were first described by the writer in 1953 (1). The causal fungus was found to be Phytophthora cryptogea Pethy. & Laff. (2). Although the disease has been seen frequently in the San Joaquin, Sacramento, and Antelope Valleys of California since 1953, it was not until early 1955 that it was first noted in the Imperial Valley, on a farm which had been reclaimed from the desert only one year prior to the occurrence of the disease. In most fields affected by Phytophthora root rot, soils are heavy and have a high moisture-holding capacity. In this field, however, the soil contained a high percentage of sand, and drainage was such that it was necessary for the grower to irrigate every 7 to 10 days. This pratice apparently provided optimum conditions for infection by the fungus. Increasing the dry interval between irrigations seemed to arrest the disease slightly but did not control it. The stand was eventually so depleted that it could not be economically maintained. Phytophthora root rot has since been found in several other fields in the Imperial Valley in which there are clay soils having a high moisture-holding capacity.

Because Phytophthora root rot seems to be widely distributed in California, a program has been initiated to seek resistant plants. None of the popular alfalfa varieties has shown resistance in tests conducted thus far.

Host-range tests reported in 1954 (2) indicated that the fungus was severely pathogenic only to alfalfa. Since these tests were not exhaustive, more extensive tests to include more crops are being conducted.

BACTERIAL WILT

Bacterial wilt (5), caused by Corynebacterium insidiosum (McCull.) H. L. Jens., is becoming more prevalent in counties south of the Tehachapi Mountains. The causal organism has been isolated from diseased plants from fields in Riverside, Orange, Los Angeles, San Bernardino, Ventura, Santa Barbara, and Imperial Counties. The first occurrence of this disease in Imperial County was reported to the writer by Farm Advisor Robert Kortsen, in 1954. It has not been identified in the Coachella or Palo Verde Valleys.

Soil temperatures are commonly extremely high during the summer months in the Coachella, Palo Verde, and Imperial Valleys. Some soil temperature data for the Imperial Valley for 1951[3] show that temperatures at a 3 1/2-inch depth reached an average maximum of 100° F in July in soil with no vegetation. Winter and spring soil temperatures were moderate, and maxima ranged from 58° to 73° F at a 3 1/2-inch depth from February to April. In 1955 in other fields the writer noted summer soil temperatures as high as 108°-110° F at 2-inch depths. Some unofficial reports indicate higher maxima than these in this area.

Jones and McCulloch (5) reported cardinal temperatures of 1°, 21°-24°, and 31° C (approximately 34°, 70°-75°, and 88° F) for the growth of Corynebacterium insidiosum in culture. If the data of these workers apply to the isolates from the Imperial Valley, winter soil temper-

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[3] Data kindly supplied by Dr. H. B. Schultz, of the Department of Agricultural Engineering, University of California, Davis, from records taken at Imperial Valley Field Station, El Centro, California, 1951 and 1952. These records do not necessarily represent mean soil temperatures for the Imperial Valley, but serve as examples.

atures should be ideal for pathogenesis. As yet no tests have been made to determine the cardinal temperatures for growth of the Imperial Valley isolates. Since alfalfa roots grow deep into the soil, the bacterial wilt organism could probably survive during the summer in roots at 1- to 2-foot depths, where soil temperatures do not reach such great extremes.

The delayed appearance of bacterial wilt in the Imperial Valley may be partly explained by the fact that alfalfa hay has seldom been transported into this area from infested areas, commercial movement of hay being mainly toward the Los Angeles feeding and dairy enterprises. Since the bacterial wilt organism may be disseminated in affected forage, on implements, or in irrigation water, the incidence of this disease may be expected to increase in the southern California area.

Fortunately, the resistant variety Caliverde, developed by Stanford and Houston of the University of California at Davis, is well adapted to most of the southern California area except the Imperial, Coachella, and Palo Verde Valleys, where it fails to produce as much forage in the winter as the adapted varieties Africa or India.

DWARF

The incidence of the dwarf disease of alfalfa (3, 9), caused by a virus and transmitted by several species of leafhoppers, may be decreasing in the southern California area. In 1953 dwarf was found in only 5 fields, whereas bacterial wilt was found in 23. This information may not indicate a true ratio of the occurrence of the two diseases but does show that dwarf was the less prevalent disease at that time. The reason for the decreased incidence of dwarf is not definitely known but may be associated with decreased insect vector populations. By using the variety California Common 49 (4), which is tolerant to the virus, the life of a profitable stand can be extended at least 1 to 2 years. Dwarf has not been seen in the Imperial, Coachella, or Palo Verde Valleys.

RHIZOCTONIA ROOT CANKER

Rhizoctonia root canker, caused by Rhizoctonia solani Kuehn (7), is responsible for great economic loss to growers in the Imperial and Palo Verde Valleys. It is favored by high soil temperatures and is most prevalent during the period from July to October.

Not all strains of Rhizoctonia associated with this disease are capable of causing it. Approximately 100 isolates from alfalfa, flax, and cotton have been tested on alfalfa, and only three have reproduced symptoms of root canker. Many isolates were pathogenic to seedlings but not to plants 1 to 2 months old. This information confirms and agrees with that reported by Smith (8). Since no control is known, it is probably the most serious disease of known cause in the irrigated desert valleys.

SCALD

The scald disease of alfalfa is nearly equal to Rhizoctonia root canker in economic importance. During periods when soil temperatures are at their highest in the hot, irrigated desert valleys, a nearly complete loss of stand of alfalfa may follow a heavy irrigation. Foliage of affected plants commonly turns yellow, and a tan discoloration of the xylem tissue of the root occurs. In 4 to 10 days most of the plants in the affected area wilt and die. It has been determined experimentally that alfalfa plants growing in potted Imperial Valley soil were damaged when soil temperatures were held at 100° F for 24 hours, but only when soil was saturated. Thus, the high temperature alone is not responsible for plant death. Alfalfa plants in well-drained soil withstood soil temperatures up to 113° F without showing visible damage. These results are preliminary; a more detailed account of a current investigation will be reported later.

Scald has been controlled by some growers who carefully prepare the land for irrigation prior to planting and do not allow an excess of water to stand on the alfalfa after irrigation. Many growers stop irrigation completely from late July to September and do not attempt to harvest during this period. The purpose is to avoid scald and to prevent domination of alfalfa by certain grasses that grow luxuriantly at high temperatures. This practice prevents scald but results in severe desiccation of alfalfa taproots and the death of many plants.

In the Imperial and Palo Verde Valleys a large number of alfalfa fields are affected each summer by either scald or Rhizoctonia root canker, with stand reduction ranging from 10 to 100 percent.

Renovation of fields with a disc, spring-tooth harrow, or subsoiling equipment, followed by replanting at a rate of 20 to 30 lbs. of alfalfa seed per acre during September or October, is a common agricultural practice in this area. The new stand is established quickly, and a full stand is obtained during the winter. This growth is usually pastured by sheep, and hay crops are harvested the following spring and summer. Approximately 7 to 9 crops are harvested per year. This is probably one of the few areas in the United States where replanting alfalfa in an old stand is profitable. This practice serves to make alfalfa-growing economically practicable despite the serious damage done by Rhizoctonia and scald during the period from July to October.

DISCUSSION

A program designed to investigate the causes of the root diseases of alfalfa in southern California has been under way since 1953. Some of the findings are reported here. This study seemed to be a logical procedure basic to future work in developing improved alfalfa varieties. Because of the unique environmental conditions of the irrigated desert valleys, and the diseases of alfalfa which occur in these areas, a more disease-resistant variety is most desirable. The two diseases, Rhizoctonia root canker and scald, recur year after year and are the most serious factors involved in stand depletion. A search for an alfalfa tolerant to Rhizoctonia solani is under way, but has thus far not revealed any varieties that are truly resistant. Bacterial wilt, Phytophthora root rot, and anthracnose must be considered to be of great potential importance if they become more prevalent.

Alfalfa is one of the most valuable crops grown in southern California. The foregoing account indicates that an understanding of the cause and control of alfalfa diseases is fundamental to future varietal improvement of the crop.

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LATE SEASON DISEASES ON FORAGE CROPS IN NEW HAMPSHIRE IN 1955[1]

R. A. Kilpatrick and G. M. Dunn[2]

A survey of diseases affecting Ladino clover in New Hampshire was made in August, September and October, 1955. Frequent stops were made to determine the kind of leaf, petiole, root and stolon diseases. In fields of mixed stands observations were also made on other forage plants. The results reported herein are based on observations of approximately 150 fields throughout the State.

DISEASES OF LADINO CLOVER

Pepper spot (Pseudoplea trifolii) was commonly found in the southern portion of the State, in most fields. The disease was abundant on the petioles as well as on the leaflets. In some areas premature defoliation was apparent while in other areas little injury was noted. The disease appeared to be more prevalent after the first frost.

Cercospora leaf spot (Cercospora zebrina) was of common occurrence throughout the State. Two types of leaf symptoms were noted in addition to linear lesions on the petioles. Leaf lesions were primarily rectangular although circular lesions were frequently found. This leaf spot was more prevalent during latter August than in October.

Target spot (Stemphylium sarcinaeforme) was found in the southern portion of the State in many fields. Lesions on Ladino clover were much smaller and more numerous than those on red clover. The disease appears to be of minor importance in relation to other diseases of Ladino clover.

Viruses (complex) were found in several fields. The typical mottling, chlorosis, stunting and necrosis were observed in many fields. In most cases, only localized areas were showing infected plants. The extent of injury will be observed more closely in years to follow.

Sooty blotch (Cymadothea trifolii) was found in many fields throughout the State. The disease was most prevalent in the northeastern and eastern sections. Thirty-five to 65 percent of the leaflets were infected in a random sample collected in northern New Hampshire. Some leaflets showed 100 percent infection while others showed only trace amounts. Injury to the stand was apparent in several fields.

Stagonospora leaf spot (Stagonospora meliloti) was the most common disease of Ladino clover in New Hampshire. The amount of infection varied considerably between fields. Partial defoliation was noted in several fields.

Powdery mildew (Erysiphe polygoni) was found in a few fields but was of minor importance.

Rust (Uromyces trifolii trifolii-repentis) was of general occurrence. The disease was most noticeable on plants of old stands where leaflets and petioles were heavily infected and pustules were large. Individual plants growing along roadsides were heavily infected. Plants showing either the uredial or aecial stages were frequently found.

Stolon rots (complex) were found in many fields in the southern part of the State. The symptoms were, in general, quite similar in the type of discoloration. Isolations from infected portions have yielded such fungi as: Fusarium oxysporum, F. roseum, Gliocladium roseum, Rhizoctonia solani, Colletotrichum destructivum, and many others. Stolon rots appear to be of major importance, particularly in areas of limited cover.

Curvularia leaf spot (Curvularia trifolii) was found in fields throughout the State. Individual leaflets showed heavy infection although the percentage of infected plants varied within fields. This disease appeared to be of importance in only a few fields.

DISEASES OF RED CLOVER

Target spot (Stemphylium sarcinaeforme) was present in every field of red clover. The

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[2] Pathologist, Field Crops Research Branch, Agricultural Research Service, United States Department of Agriculture, and Associate Agronomist, New Hampshire Agricultural Experiment Station, cooperating, respectively.

disease appears to be of major importance on mature plants. Leaf lesions were frequently large and showed distinct zonation. Some defoliation was observed.

Powdery mildew (Erysiphe polygoni) was one of the most noticeable diseases. Plants oftentimes appeared white due to the presence of the fungus. The disease occurred in virtually every field of red clover. Injury was evident as the photosynthetic area was greatly reduced. The heaviest amount of infection was noted on mature plants.

Rust (Uromyces trifolii fallens) lesions were quite large on stems and leaflets of 2-year-old plants. When fields were mowed frequently rust was of minor importance, whereas in fields of lush growth and infrequent cutting rust was common.

Sooty blotch (Cymadothea trifolii) was general in occurrence throughout the State. The amount of infection varied considerably between and within individual fields and in comparison to other diseases was of little importance.

Diseases of minor importance observed on red clover were: northern anthracnose (Kabatiella caulivora), pepper spot (Pseudoplea trifolii), black stem (Phoma trifolii), root and crown rots (complex), bacterial leaf spot (Pseudomonas syringae), Stagonospora leaf spot (Stagonospora meliloti), viruses (complex), and Cercospora leaf and stem spot (Cercospora zebrina).

DISEASES OF ALFALFA

Common leaf spot (Pseudopeziza medicaginis) was frequently found on alfalfa leaflets. This disease was most prevalent and in many areas was of major importance. A considerable amount of defoliation was noted in some fields.

Spring black stem (Ascochyta imperfecta) was of common occurrence in all fields. Infection of older plants was more common than on young plants. The disease appears to be of importance in older stands.

Downy mildew (Peronospora viciae) was only found occasionally. This disease appears to be of minor importance.

Stemphylium leaf spot (Stemphylium botryosum) was of common occurrence. Defoliation of infected leaflets was noted in some areas but in general was of minor importance.

Diseases of less importance were: rust (Uromyces striatus medicaginis), and Stagonospora leaf spot (Stagonospora melitoti).

DISEASES OF OTHER FORAGE CROPS

TIMOTHY: Tar spot (Phyllachora graminis) was observed in one field. Leaves of most plants appeared to be 100 percent infected and severe injury was apparent in this field. Rust (Puccinia graminis phlei-pratensis) was commonly found although the extent of injury was of minor consequence.

BROME GRASS: Brown spot (Pyrenophora bromi) was of common occurrence in second year stands. Leaf lesions on seedlings were hardly evident while on older plants severe necrosis was common. This appears to be a major leaf disease of brome grass in New Hampshire.

VETCH: Brown spot (Botrytis cinerea) was observed on volunteer plants throughout the State. Defoliation of lower leaflets was quite common and new leaflets showed a considerable number of lesions. The disease appears to be of major importance in this area. Rust (Uromyces fabae) was observed in different areas. Large pustules were common on both leaflets and petioles. In most areas of heavy infection only the new leaves were still on the plants. Older leaves frequently fell-off at the movement of the plant due to heavy infection.

TREFOIL: Target spot (Stemphylium loti) was severe on plants near Dover. Infected leaflets were showing large lesions; chlorosis and a considerable amount of defoliation had occurred. This disease appears to be of major importance in this area.

NEWLY OBSERVED DISEASES

The following diseases are reported as being recognized in New Hampshire for the first time.

Ladino clover -- target spot, viruses, Stagonospora leaf spot, powdery mildew, rusts, stolon rot complex, and Curvularia leaf spot.

Red clover -- northern anthracnose, black stem, bacterial leaf spot, and Stagonospora leaf spot.

Alfalfa -- spring black stem, downy mildew, Stemphylium leaf spot, rust, and Stagonospora leaf spot.

Timothy -- tarspot.

Vetch -- brown spot, and rust.

FIELD CROPS RESEARCH BRANCH, AGRICULTURAL RESEARCH SERVICE, U. S. DEPARTMENT OF AGRICULTURE, AND NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION

TOP ROT OF PEARL MILLET CAUSED BY FUSARIUM MONILIFORME[1]

Homer D. Wells[2]

Many plants within an inbred line (inbred line No. 18) of pearl millet (Pennisetum glaucum) failed to produce seed heads when grown at the University of Georgia Coastal Plain Experiment Station, Tifton, Georgia, in 1954. When the leaf whorl at the top of a plant was unrolled, a rot was discovered. The flowering raceme and immature leaves that remained in the whorl were rotted and covered with a mass of white mycelium. In many of the plants affected by the top rot, each node from the base upward showed evidence of infection beneath the sheath. Monoconidial isolates and isolates obtained from plating pith tissue aseptically on poured "V-8" Juice agar plates were characteristic of Fusarium moniliforme Sheldon.

The pathogenicity of Fusarium moniliforme to pearl millet inbred line No. 18 was tested by inoculating 20 shoots in September, 1955. A hypodermic syringe was used to inject a conidial suspension of F. moniliforme into the whorl of shoots which had not yet produced seed heads. Within 10 days most of the inoculated plants showed typical top rot symptoms. Some of the shoots that were apparently more mature elongated and produced seed heads in spite of the disease. When this occurred, small necrotic areas that failed to develop further were found in the vicinity of the hypodermic punctures. The uninoculated controls developed normally.

On October 1, 1955, the regrowth of inbred lines of pearl millet was inoculated by hypodermic injection with a conidial suspension of the F. moniliforme obtained from inbred line No. 18. Observations suggested that the plants were inoculated when they were too mature to differentiate susceptibility to the top rot organism. Both inoculated and uninoculated plants died from causes other than top rot. The inoculated regrowth of inbred line No. 18, however, showed typical top rot symptoms in many cases.

Luttrell (1) recently described the diseases that occur on pearl millet in Georgia. He also listed some additional diseases that cause damage in other areas where millet has long been one of the chief grain crops. Among the diseases not previously reported on this host in the United States is top rot ("twisted top" or "Pokkah Boeng") caused by Fusarium moniliforme. This disease has been reported by Ramakrishnan (2) on pearl millet in India.

Since F. moniliforme has been reported as a pathogen on a number of Gramineae throughout the United States (3, 4), one would expect that the disease, if present, would have damaged pearl millet earlier in Georgia. It is suggested that perhaps most commercially grown pearl millet is highly resistant to or immune from top rot. This idea is supported by the observation that only one of the four inbred lines interplanted in the field during 1954 was affected and that Starr millet had been grown in this field for a number of years previously without suffering damage from the disease. The same field was used for Starr millet seed production again during 1955 without any difficulty from the disease.

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DISEASES OF GRASSES IN KANSAS: 1953-55[1]

Clark T. Rogerson[2]

Abstract

A study of grass diseases in Kansas was made during 1953, 1954, and 1955. Particular attention was given to native prairie grasses, weedy grasses, and introduced and native grasses being tested in the grass breeding nurseries of Kansas State College. Seventeen fungi, previously unreported for Kansas, were found associated with grass diseases. These include: Ascochyta graminea on Cynodon dactylon; Ascochyta sorghina on Sorghum halepense and Sorghum vulgare var. sudanense; Cercospora echinochloae on Echinochloa crusgalli; Cercospora fusimaculans on Leptoloma cognatum; Curvularia geniculata on Poa pratensis; Helminthosporium cynodontis on Cynodon dactylon; Helminthosporium dictyoides on Festuca arundinacea; Helminthosporium halodes on Sporobolus cryptandrus; Helminthosporium leersiae on Leersia virginicus; Selenophoma bromigena on Bromus inermis; Selenophoma everhartii on Panicum scribnerianun: Sphacelotheca destruens on Panicum dichotomiflorum; Stagonospora arenaria on Agropyron trichophorum; Stagonospora bromi on Bromus inermis; Stagonospora vexatula on Phragmites communis; Ustilago cynodontis on Cynodon dactylon; and Ustilago sphaerogena on Echinochloa crusgalli.

In addition 30 new Kansas host records were obtained: Ascochyta sorghi on Poa pratensis and Setaria viridis; Claviceps purpurea on Bromus inermis; Colletotrichum graminicola on Digitaria sanguinalis, Poa pratensis and Sorghum halepense; Epichloë typhina on Elymus virginicus; Erysiphe graminis on Agropyron repens and Poa compressa; Gibberella zeae on Andropogon scoparius; Helminthosporium sorokinianum on Poa pratensis; Phyllosticta sorghina on Panicum virgatum and Setaria viridis; Piricularia grisea on Setaria lutescens; Pleospora trichostoma on Bromus inermis; Puccinia coronata on Lolium perenne; Puccinia eatoniae on Sphenopholis nitida; Puccinia graminis on Poa arida; Puccinia recondita on Agropyron intermedium and Agrostis alba; Puccinia sessilis on Phalaris caroliniana; Rhizoctonia solani on Poa pratensis; Scolecotrichum graminis on Poa compressa; Selenophoma donacis on Agropyron sp.; Septoria bromi on Bromus japonicus and Bromus secalinus; Sorosporium provinciale on Andropogon hallii; Sphacelotheca occidentalis on Andropogon scoparius; Ustilago striiformis on Dactylis glomerata and Poa compressa.

Two hyperparasites, Darluca filum and Botrytis uredinicola, on rust pustules on Panicum virgatum were noted. Notes on additional grass diseases are given.

During 1953, 1954 and 1955 the fungi associated with diseases of grasses in Kansas were studied. Field observations and collections were made on native prairie, weedy, and cultivated grasses. Particular attention was given to the native and introduced grasses which are being tested in the plant breeding grass nurseries of Kansas State College. Several new fungus and host records were obtained. Some of the observations appear to be unusual and worthy of record.

All three years were drought years in Kansas, particularly during the late summer and fall, with only a few areas receiving normal precipitation. Observations and collections were made from plants in a natural environment; in a few cases, however, the host plants had been irrigated. Specimens of all the diseased plants have been deposited in the Mycological Herbarium at Kansas State College and in the National Fungus Collections at Beltsville, Maryland. Unless otherwise indicated, the collections were made by the author.

AEGILOPS CYLINDRICA Host. JOINTED GOATGRASS

Stem rust, Puccinia graminis Pers., was found on this host in a wheat field in Ellis Co., June 10, 1954. Only a few uredia were found on the leaves of the goatgrass while the wheat plants were heavily infected. In the same field natural hybrids of Aegilops x Triticum were also lightly infected with the rust.

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AGROPYRON INTERMEDIUM (Host.) Beauv. INTERMEDIATE WHEATGRASS

Leaf rust, Puccinia recondita Rob. ex Desm. (Puccinia rubigo-vera (DC.) Wint.), was abundant on leaves of certain selections of this grass in the grass breeding nursery, Riley Co. Only the uredial stage was observed. This is a new host record for Kansas and is the first record of any fungus on this host in Kansas.

AGROPYRON REPENS (L.) Beauv. QUACKGRASS

The conidial stage of powdery mildew, Erysiphe graminis DC., was found to be abundant on this host along a street in Manhattan, Riley Co., June 1953. No previous Kansas record of powdery mildew on this host has been found.

AGROPYRON SMITHII Rydb. WESTERN WHEATGRASS

The uredial stage of leaf rust, Puccinia recondita Rob. ex Desm. (Puccinia rubigo-vera (DC.) Wint.), was abundant and serious on leaves, culms, and glumes of certain selected strains of this grass being tested in the grass nursery, Riley Co., July 1953.

Stem rust, Puccinia graminis Pers., was found on leaves in June 1955, Smith Co. (uredial stage) and in October 1955, McPherson Co. (both uredial and telial stages). Infection was mild in both cases.

AGROPYRON TRICHOPHORUM (Link) Richt. PUBESCENT WHEATGRASS

Purple-brown blotch, Stagonospora arenaria Sacc., appeared on certain selections of this grass in the grass nursery, Riley Co., July 1953. This is a new host record for Kansas and the first record of a fungus on this host for Kansas.

AGROPYRON SP. WHEATGRASS

Selenophoma donacis (Pass.) Sprague & A. G. Johns., which causes stem-speckle, was isolated from small, brown to black spots with yellow margins on leaves of an unidentified wheatgrass at the grass breeding nursery, Riley Co., June 1953. On potato dextrose agar medium leathery colonies with irregular borders were produced. They were pink to red or deep reddish brown. Black pycnidia were abundantly produced in culture and the conidia were "boomerang shaped". This is the first record for Kansas of a Selenophoma on any species of Agropyron.

AGROSTIS ALBA L. REDTOP

Leaf rust, Puccinia recondita Rob. ex Desm. (Puccinia rubigo-vera (DC.) Wint.) (uredial stage), was abundant on plants of redtop over an extensive bottomland meadow, Ottawa Co., July 1953. No Kansas record on this host had been found.

ANDROPOGON GERARDI Vitm. BIG BLUESTEM

Leaf rust, Puccinia andropogonis Schw. (uredial and telial stages), was abundant and severe on selections of this host being tested in the grass breeding nursery, Riley Co., July-September 1954 and 1955. The rust was equally severe on irrigated and nonirrigated plants. Some selections of the host appeared to be resistant.

Leaf rust, Puccinia tripsaci Diet. & Holw., has been determined on selections of the host in the grass nursery, Riley Co., August 1955. Only the uredial stage was present, the urediospores being globose, 26-28 microns in diameter, with the wall averaging 3 microns in thickness and definitely echinulate.

Head smut, Sorosporium provinciale (Ell. & Gall.) Clint., was abundant on certain selections of big bluestem in the grass nursery, Riley Co., August 1953, but was absent in 1954 and 1955.

ANDROPOGON HALLII Hack. SAND BLUESTEM

Leaf rust, Puccinia andropogonis Schw. (uredial and telial stages), was abundant and severe in the grass nursery, Riley Co., July-August 1953-1955, both on irrigated and nonirrigated plants. Some selections showed considerable resistance.

Head smut, Sorosporium provinciale (Ell. & Gall.) Clint., was particularly severe at the grass nursery, Riley Co., June-July 1955. One field of a selection planted for increase was about 80 percent infected. This is a new host record for Kansas. Fischer (1) and Weiss (6) do not list this smut on A. hallii.

Seed smut, Sphacelotheca occidentalis (Seym.) Clint., was present in small amounts at the grass nursery, Riley Co., August 1953.

ANDROPOGON SCOPARIUS Michx. LITTLE BLUESTEM

Seed smut, Sphacelotheca occidentalis (Seym.) Clint., was collected in Greenwood Co., June 1954. This smut apparently had not been reported on little bluestem from Kansas.

Perithecia of Gibberella zeae (Schw.) Petch were abundant on dead culms and sheaths of clumps of little bluestem which appeared to have died with a crown and root rot disease. Roots of the plants had rotted completely. The violet perithecia were superficial in small groups on the host tissue. Asci were clavate, 85-90 x 8-9 microns, usually with only 4 ascospores per ascus. Ascospores were hyaline, narrow, cymbiform, 3-septate, smooth 25-28 x 5-6 microns.

ARISTIDA OLIGANTHA Michx. PRAIRIE THREEAWN

Tar spot, Dothidella aristidae (Schw.) Ell. & Ev. (conidial stage), was found on plants in a prairie pasture area, Ottawa Co., June 1954. Black stromata were prominent on the leaf blades. A layer of conidiophores bearing small, elliptic, hyaline conidia, 6-10 x 2-3 microns, developed under the black stromatic crust. No evidence of asci was detected. This is a new host record for Kansas. The specimen agreed in all respects with a collection (Bartholomew No. 793) from Rooks Co., December 1892 on purple threeawn, Aristida purpurea Nutt.

BOUTELOUA CURTIPENDULA (Michx.) Torr. SIDEOATS GRAMA

Rust, Puccinia vexans Farl. (uredial and telial stages), was abundant and severe on certain selections at the grass nursery, Ellis Co., June 1954.

BOUTELOUA GRACILIS (H.B.K.) Lag. BLUE GRAMA

Head smut, (Ustilago neglecta Niessl, was abundant in a prairie area, Ford Co., August 1955 (collected by R. L. McGregor).

BROMUS INERMIS Leyss. SMOOTH BROME

Ergot, Claviceps purpurea (Fr.) Tul. (sclerotial stage), was common in a cultivated field, Brown Co., June 1954. Also trace amounts were found in Nemaha and Marshall counties. Ergot has not been reported previously on brome in Kansas. Diligent search failed to reveal its presence in 1955.

Leaf spot, Pleospora trichostoma (Fr.) Ces. & de Not. (Pyrenophora bromi Drechs.), caused alarm among growers during the spring and early summer of 1953. The first leaves in some Kansas localities were covered by small dark brown or black spots with yellow margins. These lesions elongated and through coalescence covered entire blades causing a blighted condition of the plants. As dry weather became prevalent, fewer spots developed as new leaves appeared and by mid-summer the disease was not noticeable. Isolations from the spots yielded gray to black colonies of a fungus which remained sterile on potato dextrose agar medium at room temperatures. However, when the cultures were placed at 10° C for about 3 months, ascostromata of the fungus were produced. Ascospores were uniform, light brown, 50-62 x 23-25 microns, 3-septate with longitudinal septa in the middle segments. The conidial stage, Helminthosporium bromi Drechs., was not observed on the diseased plants nor were conidia produced in culture. Identifications were made from Jackson and Riley Counties. This disease had not been reported from Kansas.

Scald, Rhynchosporium secalis (Oud.) J. J. Davis, proved to be common during 1953 in the grass nursery, Riley Co., June-August. Many selections were infected; a few indicated resistance. This disease has been recorded on barley from Kansas but apparently this is the first report on brome.

Leaf spot, Selenophoma bromigena (Sacc.) Sprague & A. G. Johns., was found in cultivated fields at two points in Kansas, during May and June 1953, in Republic and Morris Counties. It was not noted in 1954 but was collected on brome in a roadside planting, Pottawatomie Co., June 1955. In the latter collection spotting was very severe and considerable necrosis of the foliage occurred. This is a new fungus and host record for Kansas.

Leaf blotch, Stagonospora bromi A. L. Sm. & Ramsb., appeared on a selection of brome in the grass nursery, Riley Co., June 1953 and also was collected along roadsides in Republic Co., June 1953, in Labette and Neosho Counties, May 1954, and in Linn Co., June 1954. It was common in Riley Co., in June 1953. This is a new host and fungus record for Kansas.

BROMUS JAPONICUS Thunb. JAPANESE CHESS

Leaf blotch, Septoria bromi Sacc., was abundant along roadsides and in fields, during June 1955, in Wilson and Woodson Counties. This is a new host record for Kansas.

Loose smut, Ustilago bullata Berk., was found on the inflorescences of this host in an overgrazed pasture, Riley Co., June 1955.

BROMUS SECALINUS L. SOFT CHESS

Leaf botch, Septoria bromi Sacc., occurred in abundance in Bourbon and Woodson Counties, May and June 1955. This is a new host record for Kansas.

BUCHLOË DACTYLOIDES (Nutt.) Englm. BUFFALOGRASS

False smut, Cercospora seminalis Ell. & Ev., was collected in Riley Co., August 1955.

Leaf spot, Helminthosporium buchloës LeFebvre & A. G. Johns., apparently caused browning of a small buffalograss lawn, Riley Co., June 1955. The upper two-thirds of the leaves became heavily spotted and conidia and conidiophores were abundant on the necrotic areas. Conidia were obclavate, fuliginous, indistinctly septate, 44-50 x 8.5-11 microns.

CENCHRUS PAUCIFLORUS Benth. FIELD SANDBUR

Inflorescence smut, Sorosporium cenchri Henn., appeared to be fairly common and widespread during 1955. Collections were made in Riley Co., July and October, and in Marion Co., October. Fischer (1) listed this smut from Kansas on Cenchrus tribuloides L. However, that host species is not known to occur in Kansas and hence the host record probably should refer to C. pauciflorus.

CHLORIS VERTICILLATA Nutt. WINDMILL FINGERGRASS

Rust, Puccinia chloridis Speg. (uredial stage), appeared on leaves of this host in a lawn, Riley Co., June 1955. Uredia were inconspicuous.

CYNODON DACTYLON (L.) Pers. BERMUDAGRASS

Pycnidia of Ascochyta graminea (Sacc.) Sprague & A. G. Johns. developed in the field on necrotic tips of leaves of Bermuda grass which apparently had been damaged by drought conditions, Riley Co., October 1955. This fungus had not been reported from Kansas.

Leaf mold, Helminthosporium cynodontis Marig., was abundant on dying foliage of Bermuda grass in a lawn, Riley Co., October 1955. Conidiophores were produced in black patches on the dead blades and sheaths and also on white to buff spots. They were dark brown, single or in groups. Conidia were elongate, slightly curved, fuliginous, 9-septate, 50-70 x 10-13 microns. Elongate purplish lesions developed on the leaf blades. Isolations from these lesions failed to produce any organisms in culture. This is a new record for Kansas.

Inflorescence smut, Ustilago cynodontis (Pass.) P. Henn., was collected for the first time in Kansas in Sumner Co., May 1953 on plants along a roadside. In 1954 collections of the smut were submitted by county agents from Barber Co., September, and Sumner Co., August. A visit to the locality of the latter collection, a cemetery, revealed a 50 percent or more infection of the inflorescences. All three of these localities are near the southern border of Kansas.

DACTYLIS GLOMERATA L. ORCHARDGRASS

Anthracnose, Colletotrichum graminicola (Ces.) G. W. Wils., caused severe blighting of leaves in a small area, Riley Co., October 1954.

Brown stripe, Scolecotrichum graminis Fckl., appeared to be the most serious disease of orchard grass in Kansas. During all three seasons, 1953-1955, considerable necrosis and often a complete killing of the leaves occurred. Every selection in the grass nursery showed some degree of susceptibility and all planted or escaped plants examined throughout Riley Co. proved to be diseased.

Stripe smut, Ustilago striiformis (Westend.) Niessl, was collected at two localities during 1954: Riley Co., November, and Pottawatomie Co., May. This is a new host record for Kansas.

DIGITARIA SANGUINALIS (L.) Scop. HAIRY CRABGRASS

Anthracnose, Colletotrichum graminicola (Ces.) G. W. Wils., was found on this host in Riley Co., October 1954. This is a new host record for Kansas.

Loose smut, Ustilago syntherismae (Schw.) Peck, was found in Riley Co., October 1954.

DISTICHLIS STRICTA (Torr.) Rydb. INLAND SALTGRASS

Tar spot, Phyllachora diplocarpa (Ell. & Ev.) Ell. & Ev., was found on plants along the

Arkansas River, Ford Co., August 1955 (collected by R. L. McGregor). Asci were 60-77 x 14-15 microns. Ascospores were inordinately arranged, 14-16 x 8-9 microns. These measurements were slightly larger than those given by Orton (3). The fungus was described originally from a Bartholomew collection made in Rooks Co. The host was given as Distichlis maritima Raf. Orton (3) and Weiss (7) recorded the fungus on Distichlis spicata (L.) Greene (with D. maritima as a synonym). However, D. spicata is not known to occur in Kansas; hence, it is suspected that the type collection was made on D. stricta.

ECHINOCHLOA CRUSGALLI (L.) Beauv. BARNYARDGRASS

Leaf spot, Cercospora echinochloae J. J. Davis, was severe on plants, Riley Co., July 1955. Spots were elongate between the leaf veins and reddish-brown. Conidiophores were hypophyllous and in groups of 10-15 protruding through the stomates. Conidia were hyaline, obclavate, 1-5 septate and 4-6 x 50-55 microns. This is the first report of the fungus for Kansas. Dr. Charles Chupp confirmed the identification.

Anthracnose, Colletotrichum graminicola (Ces.) G. W. Wils., was present on leaves and sheaths in Riley Co., September 1954 and July 1955.

Loose smut, Ustilago sphaerogena Burr., was collected by R. L. McGregor in Woodson Co., July 1955. This is the first report of this smut for Kansas.

ELYMUS CANADENSIS L. CANADA WILDRYE

Ergot, Claviceps purpurea (Fr.) Tul. (sclerotial stage), was abundant over an extensive area in Riley Co., July 1954.

Stem rust, Puccinia graminis Pers., was severe during 1953, the uredia often covering leaves, leaf sheaths, glumes, and awns. Collections were made from Jewell, Ottawa, and Wabaunsee Counties, July. It was much less common on this host during 1954 and 1955.

Leaf rust, Puccinia recondita Rob. ex Desm. (Puccinia rubigo-vera (DC.) Wint.), occurred in widespread localities during all three years. Collections were made in Ottawa Co., July 1953, Sumner Co., May 1954, Linn Co., June 1954, and Woodson Co., June 1955. Only the latter collection contained both uredial and telial material; the others consisted only of the uredial stage.

Brown stripe, Scolecotrichum graminis Fckl., was abundant in widespread areas during 1955 but was seen only once in 1954 and was not noted in 1953. Collections were made as follows: Sumner Co., May 1954, Riley Co., June 1955, and Cherokee Co., June 1955.

Leaf smut, Urocystis agropyri (Preuss) Schroet., was collected in two areas during June 1955: Lane and Ness Counties.

ELYMUS VIRGINICUS L. SOUTHERN WILDRYE

Ergot, Claviceps purpurea (Fr.) Tul. (sclerotial stage), was abundant in the same area as mentioned above under E. canadensis.

Choke, Epichloë typhina (Pers. ex Fr.) Tul., was found infecting plants over an extensive area along the banks of the Smoky Hill River, Ottawa Co., June 1953, and in a wooded area, Crawford Co., June 1954. This is a new host record for Kansas.

Stem rust, Puccinia graminis Pers. (uredial stage), was particularly severe on certain selected clones being tested in the grass nursery, Riley Co., June 1953. A heavy infection of glumes was noted in a collection made during July 1954, in Riley Co. Telial material was found in September 1954, Riley Co.

Leaf rust, Puccinia recondita Rob. ex Desm. (Puccinia rubigo-vera (DC.) Wint.) (uredial and telial material), was found to be severe in an extensive area along the banks of a creek, Riley Co., July 1955.

Brown stripe, Scolecotrichum graminis Fckl., was severe and widespread during 1955 in Riley Co., May and June 1955.

Leaf smut, Urocystis agropyri (Preuss) Schroet., was found in Riley Co., May 1953.

FESTUCA ARUNDINACEA Schreb. TALLMEADOW FESCUE

Net blotch, Helminthosporium dictyoides Drechs., appeared on a selected clone at the grass nursery, Riley Co., June 1954. The other clones appeared to be resistant. This is the first record of the disease and fungus for Kansas.

HORDEUM JUBATUM L. SQUIRRELTAIL GRASS

Stem rust, Puccinia graminis Pers. (uredial stage), was severe on leaves and culms on plants in an extensive pasture area, Ottawa Co., 1953.

HORDEUM PUSILLUM L. LITTLE BARLEY

Brown stripe, Scolecotrichum graminis Fckl., was common in two counties (Labette and Neosho) of southeastern Kansas during May 1954.

LEERSIA VIRGINICA Willd. WHITEGRASS

Leaf spot, Helminthosporium leersiae Atk., proved to be abundant on this grass in an extensive area along the shores of a creek, Riley Co. Small, narrow, dark brown lesions 1-2 mm in diameter were first noted in July. Later the spots widened up to 3-4 mm and the center became a pale tan in color. Conidia were produced abundantly on the older leaves in both 1954 and 1955. Conidia were pale olivaceous, straight, or curved, 70-100 x 15-18 microns, mostly 7-9 septate. This is the first record of the fungus for Kansas.

LEPTOLOMA COGNATUM (Schult.) Chase FALL WITCHGRASS

Leaf spot, Cercospora fusimaculans Atk., was found for the first time in Kansas, Riley Co., September 1954. (Determined by Dr. Charles Chupp.)

LOLIUM PERENNE L. ENGLISH RYEGRASS

Crown rust, Puccinia coronata Cda. (uredial stage), was severe on this host in a lawn, Douglas Co., September 1955. (Collected by R. L. McGregor.) This is a new host record for Kansas.

MUHLENBERGIA MEXICANA (L.) Trin. WIRESTEM MUHLY

Tar spot, Phyllachora vulgata Theiss. & Syd., was found on leaves of this host, Leavenworth Co., October 1954. (Collected by R. L. McGregor.)

MUHLENBERGIA RACEMOSA (Michx.) B.S.P. MARSH MUHLY

Leaf rust, Puccinia schedonnardi Kell. & Swing. (telial stage), was severe on plants, Riley Co., October 1954.

PANICUM DICHOTOMIFLORUM Michx. FALL PANICUM

Loose smut, Sorosporium cenchri Henn., was collected by R. L. McGregor, Miami Co., September 1955.

Head smut, Sphacelotheca destruens (Schlecht.) Stev. & A. G. Johns., was collected by R. L. McGregor, Franklin Co., May 1955.

PANICUM SCRIBNERIANUM Nash PANICGRASS

Leaf spot, Selenophoma everhartii (Sacc. & Syd.) Sprague & A. G. Johns., was found on leaves on this host in a prairie area, Riley Co., September 1953. Conidia were sickle shaped, acute, 10 x 2 microns. This is a new fungus and host record for Kansas.

PANICUM VIRGATUM L. SWITCHGRASS

Tar spot, Phyllachora graminis (Pers. ex Fr.) Fckl., was severe on several selected clones in the grass breeding nursery, Riley Co., October 1955. It was also present on wild plants in areas adjacent to the nursery.

Leaf spot, Phyllosticta sorghina Sacc., occurred on many selected clones, in the grass breeding nursery, Riley Co., June 1955. Usually only one or two spots were present on the leaves of any one plant. In no case was serious damage noted. This is a new host record for Kansas.

Leaf spot, Selenophoma donacis (Sacc. & Syd.) Sprague & A. G. Johns., was severe on many selected clones in the grass nursery, Riley Co., June 1954. The spots were gray with prominent brown borders.

Leaf rust, Uromyces graminicola Burr., proved to be the most serious disease of switchgrass in the grass breeding nursery. All clones showed some susceptibility and most of them were severely damaged. The Blackwell variety was particularly susceptible. The rust was also common on native plants in widespread localities. Collections were made in Riley Co., June 1954 and October 1955 (uredial and telial stages), Dickinson Co., October 1955. Two hyperparasites were noted on this rust. Darluca filum (Biv. ex Fr.) Cast. was abundant on uredia of the rust on Blackwell switchgrass, Riley Co., September 1954, and Botrytis uredinicola Peck covered every uredium on a group of wild plants in one area, Riley Co., August 1953. Botrytis uredinicola was described originally from collections made by Bartholomew in

Rooks Co., Kansas, July 1909. It appears to have been reported rarely since then. Attempts to culture it were futile.

PHALARIS ARUNDINACEA L. REED CANARYGRASS

Buff spot, Stagonospora foliicola (Bres.) Bub., proved to be the only disease on this host in the grass breeding nursery, Riley Co., August 1953. It was severe on several selected clones. The disease was first recorded for Kansas in 1951.

PHALARIS CAROLINIANA Walt. CAROLINA CANARYGRASS

Leaf rust, Puccinia sessilis Schneid. (uredial and telial stages), was abundant on plants in a moist meadow-pasture, Cherokee Co., June 1955. This is a new host record for Kansas.

PHLEUM PRATENSE L. COMMON TIMOTHY

Brown stripe, Scolecotrichum graminis Fckl., was found in Nemaha Co., June 1955.

PHRAGMITES COMMUNIS Trin. COMMON REED

Leaf spot, Stagonospora vexatula Sacc., was found on plants along a small stream, Pottawatomie Co., November 1954. Pycnidia were associated with well developed elongate fuscous spots, surrounded by a yellow (when fresh) to brown (when dry) halo. The spots occurred for the most part on otherwise green leaves, suggesting that the organism was pathogenic. Conidia were cylindrical, usually straight, but occasionally curved, ends rounded, mostly 7-septate, hyaline, 50-55 (to 60) x 3-5 microns.

POA ARIDA Vasey PLAINS BLUEGRASS

Stem rust, Puccinia graminis Pers. (uredial stage), was severe on selections on this host in the grass breeding nursery Riley Co., June 1955. This is a new host record for Kansas.

POA COMPRESSA L. CANADA BLUEGRASS

Powdery mildew, Erysiphe graminis DC. (conidial stage), occurred on naturalized plants in a wooded area in Riley Co., May 1955. Apparently powdery mildew had not been reported for Kansas on this host.

Brown stripe, Scolecotrichum graminis Fckl., was severe on selected clones in the grass breeding nursery, Riley Co., May and June 1955. These plants were irrigated and were almost completely killed with the disease. Plants in a meadow, Johnson Co., June 1955, also showed considerable damage. This is a new host record for Kansas.

Stripe smut, Ustilago striiformis (West.) Niessl, was found on naturalized plants, Riley Co., May 1953. This is a new host record of this smut for Kansas.

POA PRATENSIS L. KENTUCKY BLUEGRASS

Pycnidia of Ascochyta sorghi Sacc. developed on blighted leaves of bluegrass plants in a lawn, Clay Co., July 1955 following a prolonged dry spell. The pycnidia were found only on the dead leaves and hence may have been a secondary development. Conidia were narrow cylindric, averaging 12-13 x 2-3 microns. The fungus was also collected on dead leaves, Lane Co., August 1955. This is a new host record for Kansas.

Anthracnose, Colletotrichum graminicola (Ces.) G. W. Wils., appeared on plants in lawns, Riley Co., July 1955 and Shawnee Co., June 1955. Spotting on the leaves was sparse but the plants appeared to be blighted. Acervuli were produced in the spots as well as on the dead terminal ends of leaves. This is a new host record for Kansas.

Fading out, Curvularia geniculata (Tracy & Earle) Boed., proved to be widespread in Kansas during the hot summer months of 1953, 1954, and 1955. Numerous queries were received regarding the dying of bluegrass in lawns. Brown spots appeared in lawns even where irrigated and the spots enlarged and spread over considerable areas. Isolations from the crowns and roots of dying plants most frequently revealed the presence of Curvularia geniculata. Since this organism has been reported to cause symptoms similar to those observed in Kansas, it was surmised that the trouble is the fading-out disease due to the Curvularia. The organism was isolated from bluegrass as follows: Ellis Co., August 1955; Lincoln Co., July 1953; Riley Co., August and October 1953, July 1955; Saline Co., 1953, June 1955; Shawnee Co., June 1955; and Wichita Co., November 1953. In one culture from Riley Co., 1953, erect columnar, black stromata appeared similar to those described for Podosporiella. The conidia and conidiophores borne at the apex of the stromata were morphologically similar to those

formed on the surface of the agar in the same plates. This type of stroma has been reported for at least two species of Helminthosporium, but no record could be found of it being associated with a species of Curvularia.

Powdery mildew, Erysiphe graminis DC. (conidial stage), appeared very early (April) on plants in Riley and Dickinson counties, 1953, and was severe in some lawns. Considerable yellowing and necrosis of foliage of Merion bluegrass was noted from Pawnee Co., November 1953.

Melting out, Helminthosporium sorokinianum Sacc. ex Sorokin (Helminthosporium sativum Pam., King, & Bakke), appeared on several irrigated Merion and Kentucky bluegrass lawns during the hot summer months. Areas of dying turf lacked a definite margin and varied from a reddish tinge to a tan or brown color. Not all plants were affected within an area. Isolations from roots, crowns and rhizomes of the dying plants yielded the organism. The fungus was identified in 1955 from Saline Co., June, Riley Co., July, and Lane Co., August. Apparently the fungus had not been reported from Kansas on this host.

Slime-mold, Physarum cinereum (Batsch.) Pers., covered extensive areas in lawns, Russell Co., July 1953, Miami Co., June 1954 and Riley Co., July 1955.

Stem rust, Puccinia graminis Pers., has caused considerable concern to the growers of Merion bluegrass. In the fall of 1953 several lawns of this variety were yellow with heavy infections, the uredia often covering most of the blade. Considerable necrosis of the leaves occurred. Telia developed on the dead leaves. A similar situation occurred in 1954 and 1955 wherever Merion bluegrass was planted. Collections on Merion bluegrass were as follows: Riley Co., October 1953 (uredia), December 1953 (telia), June 1954 (uredia), June 1955 (uredia); Dickinson Co., October 1954 (uredia); Rooks Co., June 1955 (uredia). In most cases adjacent lawns of ordinary Kentucky bluegrass were free of the rust. However, stem rust was found severely infecting ordinary Kentucky bluegrass, Riley Co., October 1954 (uredia), October 1955 (uredia), Shawnee Co., October 1954 (uredia), Ellis Co., August 1955 (uredia).

Yellow leaf rust, Puccinia poae-sudeticae (West.) Jørst. (uredial stage), was noted in several lawns. However, observations indicated that this rust was much less severe than stem rust during this period. Yellow leaf rust was found on ordinary Kentucky bluegrass, McPherson Co., May 1954, Riley Co., June 1955. It was not found on Merion bluegrass.

Brown patch, Rhizoctonia solani Kuehn, occurred in three lawns all of which were irrigated during 1953: Saline Co., July, Riley Co., July, Wichita Co., October. The determination of this disease has been based on isolations of the organism from dying plants showing typical symptoms of the disease. This appears to be the first definite record of the disease in Kansas.

Purple leaf blotch, Septoria macropoda Pass. var. septulata (Gonz. Frag.) Sprague, continued to be locally prominent especially where the grass has been protected and remained uncut, Riley Co., September 1954. It was first collected in Kansas during 1951 (5).

Stripe smut, Utilago striiformis (West.) Niessl, proved to be common in Riley Co. Extensive areas in lawns had a distinct yellowish cast in appearance during April and May 1954.

SETARIA LUTESCENS (Weigel) F. T. Hubb. YELLOW BRISTLEGRASS

Gray leaf spot, Piricularia grisea (Cke.) Sacc., was severe on plants in an extensive waste area, Riley Co., July 1955. This is a new host record for Kansas.

SETARIA VIRIDIS (L.) Beauv. GREEN BRISTLEGRASS

Pycnidia of Ascochyta sorghi Sacc. were present in spots on plants suffering from drought. The conidia averaged 6-8 x 3 microns and were elliptic, hyaline, 1-septate. The fungus may have been a secondary invader. This is an additional host record for Kansas.

Leaf spot, Phyllosticta sorghina Sacc., was abundant and severe on renewed growth of plants following rains in October 1955, Riley Co. Pycnidia were produced in elongate, dark spots. Conidia were hyaline, elliptic, and averaged 6-10 x 2-4 microns. A collection was also made in Marion Co., June 1955. This is a new host record for Kansas.

SORGHASTRUM NUTANS (L.) Nash INDIANGRASS

Rust, Puccinia virgata Ell. & Ev. (uredial and telial stages), was severe on many selected clones in the grass breeding nursery, Riley Co., September 1954 and 1955.

SORGHUM HALEPENSE (L.) Pers. JOHNSONGRASS

Rough leaf spot, Ascochyta sorghina Sacc., was found on plants along a roadside, Greenwood Co., June 1954. This is a new fungus and host record for Kansas.

Anthracnose, Colletotrichum graminicola (Ces.) G. W. Wils., was collected on roadside plants, Elk Co., November 1954. This is a new host record for Kansas.

Kernel smut, Sphacelotheca cruenta (Kuehn) Potter, proved to be common and widespread in Kansas, particularly in the southern counties where the host is prevalent. Collections were made in Greenwood and Riley Counties, June 1955, the latter being the northernmost record in the State.

SORGHUM VULGARE Pers. var. SUDANENSE (Piper) Hitchc. SUDANGRASS

Rough leaf spot, Ascochyta sorghina Sacc., was abundant and severe on many selections of this host being tested in the grass breeding nursery, Riley Co., during September and October 1954. The disease did not reappear in 1955. This is an additional host record for Kansas.

Anthracnose, Colletotrichum graminicola (Ces.) G. W. Wils., was severe on several selected clones of Wheeler sudangrass being tested in the grass breeding nursery, Riley Co., August, 1953.

Leaf blight, Helminthosporium turcicum Pass., continued to be the most serious disease on this host and was prevalent during all three seasons despite the general drought conditions. A wide range of resistance and susceptibility was indicated in the many varieties, selections, and clones being tested in the grass breeding nursery, Riley Co. A field of blighted sudangrass in Chataugua Co., was almost a total loss in 1953.

Leaf spot, Phyllosticta sorghina Sacc., occurred on selections at the grass breeding nursery, Riley Co., August, 1954 and was often present on the same leaves infected with Ascochyta sorghina. However, the spots bearing pycnidia of the Phyllosticta were large, brown, irregular in size, and often zonate, giving a target-spot effect.

Sooty stripe, Ramulispora sorghi (Ell. & Ev.) L. S. Olive & LeFebvre, appeared abundantly on many selections in the grass breeding nursery, Riley Co., September and October 1954. This was first found in Kansas during 1952 (5).

Kernel smut, Sphacelotheca cruenta (Kuehn) Potter, appeared on a few plants in the grass breeding nursery, Riley Co., October 1954.

Covered kernel smut, Sphacelotheca sorghi (Link) Clint., appeared several times on special clones being grown in the greenhouse, Riley Co., January 1953.

SPARTINA PECTINATA Link PRAIRIE CORDGRASS

Rust, Puccinia peridermiospora (Ell. & Tr.) Arth. (telial stage), was found to be common on plants in a marsh, Atchison Co., September 1954. (Collected by W. H. Horr.)

SPHENOPHOLIS NITIDA (Bieler) Scribn. WEDGEGRASS

Rust, Puccinia eatoniae Arth. (uredial and telial stages), was collected in Crawford Co., June 1955. This is a new host record for Kansas.

SPOROBOLUS CRYPTANDRUS (Torr.) A. Gray SAND DROPSEED

Leaf mold, Helminthosporium halodes Drechs., developed abundantly on dead and dying blades of plants apparently suffering with drought and damage due to tar spot, Riley Co., October 1955. This is the first report of the fungus for Kansas.

Tar spot, Phyllachora vulgata Theiss. & Syd., was found to be severe on plants, Riley Co., October 1955.

Stem rust, Puccinia graminis Pers. (uredial stage), was severe on both cultivated and adventive plants in the grass breeding nursery, Riley Co., June-October 1955.

TRIODIA FLAVA (L.) Smyth PURPLETOP

Leaf disease, Balansia epichloë (Weese) Diehl, was found to be abundant in two localities in Riley Co. The fungus was seen as early as June 15 but was most conspicuous during September. The fungus was first noted in one locality in 1951 on a few plants. Since then it has spread considerably in this locality and in 1955 several hundred plants in an extensive area were found to be infected. In most cases every leaf of an infected plant bore the ascostromata which became visible as the leaves unfolded. In all cases the ascostromata appeared on the adaxial surfaces of the leaves and were near the bases on the leaf blades. Few infected plants produced inflorescences. No evidence of the fungus could be detected on other species of grasses nearby. This disease was reported for Kansas by Diehl (2).

Rust, Puccinia windsoriae Schw. (telial stage), was common throughout Riley Co. in 1954. Collections also were made in Cherokee and Anderson counties, October 1955.

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DEPARTMENT OF BOTANY AND PLANT PATHOLOGY, KANSAS STATE COLLEGE, MANHATTAN

COVER CROPS IN RELATION TO THE BURROWING NEMATODE, RADOPHOLUS SIMILIS

Wray Birchfield and F. Bistline[1]

SUMMARY

Crotalaria spectabilis Roth and C. striata DC. failed to allow the reproduction and survival of the burrowing nematode according to inoculation experiments. Hairy indigo, Indigofera hirsuta L., proved to be a favorable host, the nematode having been dissected from the tissues in large numbers in all stages of development. It is suggested that Crotalaria would be a more desirable cover crop for cleared and treated spreading decline areas than the more commonly used hairy indigo.

INTRODUCTION

Since the report that the burrowing nematode (Radopholus similis (Cobb) Thorne) is the causal agent of the disease commonly known as spreading decline of citrus (1), the State Plant Board of Florida has adopted a program to prevent or reduce the rate of spread of this disease in the State. This program consists of pulling and burning infected trees in a diseased area plus two rows of healthy trees on the margins of infection. The cleared land is then fumigated with DD (dichloropropene-dichloropropane mixture), and left fallow for 2 years prior to replanting. A plant which would not allow the reproduction of the burrowing nematode was needed for cover on the pulled and treated areas. This report deals with experiments in search of such a cover crop. Inoculation studies were conducted in slat-houses by the research and development program of Minute Maid Corporation, and extended and confirmed in temperature tanks by the Florida State Plant Board.

INOCULATION STUDIES

In the Slathouse: Crotalaria spectabilis Roth., C. striata DC., Citrus sp., and Indifogera hirsuta L., used as test plants were grown in the slathouse in 5-quart containers of steam-sterilized soil. Inoculum consisting of about 25 grams of infected citrus roots was placed adjacent to the roots. Six replications were used. Roots of Crotalaria and of Hairy indigo were examined after about 3 months, those of citrus after about 5 months. Burrowing nematode was recovered from citrus and Hairy indigo but not from either species of Crotalaria. The burrowing nematode was recovered in small numbers from the Hairy indigo, but could not be dissected from the tissues. This nematode is an endoparasite and there was some degree of doubt as to whether or not it was reproducing on this plant. Therefore a second experiment was placed in temperature tanks optimum for infection by the burrowing nematode.

In Temperature Tanks: The tanks were of the Wisconsin type, maintained at a temperature of 74° to 76° F. Crotalaria spectabilis and Indigofera hirsuta as well as Citrus limon Burm. were used in this experiment. The plants were grown in heavily infested soil, with citrus roots from a decline area. They were watered sparingly so that no free flowing drainage was allowed, thereby forcing the nematodes to remain near the root systems. The plants were removed after about 3 months, when the roots were excised and examined according to the method reported by Young (2). Citrus limon and Hairy indigo were found to be heavily infected with burrowing nematodes, which were dissected from these plants in all stages of development. The Crotalaria remained free of the burrowing nematode. This confirmed the results of the first experiment in the slathouse. Crotalaria was replanted in the same pots, and examined several weeks later, but no burrowing nematodes were recovered from it.

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[1] Phytonematologist, Florida State Plant Board, and Research Assistant of Research and Development, Minute Maid Corporation, respectively.

DISCUSSION

Hairy indigo, a long valued and important cover crop in the citrus industry, is an efficient host of the burrowing nematode, the causal agent of spreading decline. It is inadvisable to use this plant in areas previously treated for the burrowing nematode or having a history of the organism.

Although Crotalaria spectabilis is less desirable in many respects than Hairy indigo, it is apparently immune to the burrowing nematode. It might be of particular importance as a cover crop in the pull and treat program now being employed by the State Plant Board.

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STATE PLANT BOARD OF FLORIDA AND MINUTE MAID CORPORATION

STUDIES ON CONTROL OF PEACH ROOT KNOT WITH NEMAGON IN SOUTH CAROLINA[1, 2]

H. H. Foster and L. W. Baxter[3]

Nemagon (1, 2-dibromo-3-chloropropane) has been reported to be an effective nematocide (3); and more recently the soil diffusion pattern for this compound has been mapped under field conditions (1). Under California conditions, Lear and Raski (2) recently reported that Nemagon, used at the rate of 10 gallons per acre, failed to penetrate nonrotted tomato or grape roots in amounts lethal to root knot nematodes. According to their report, gall counts indicated chemical penetration of tomato roots when applied at 20 gallons per acre; however, injury developed at this dosage. The purpose of this report is to present data from exploratory experiments that were designed to determine whether or not peach root knot caused by Meloidogyne spp. could be effectively controlled by the use of Nemagon applied to soil around living peach trees.

The acreage planted to peaches has increased rapidly during the past 2 years in Allendale, Barnwell, and adjoining counties in South Carolina. The soil type is primarily sandy loam. Most of this acreage has been planted with trees on a susceptible rootstock. Disease surveys have indicated that root-knot nematodes are a major problem confronting peach growers in this area.

During April 1955, Nemagon was applied to soil around Southland peach trees in a Barnwell County commercial peach orchard. Trees with roots found to be moderately to severely galled at the 6- to 12-inch level were selected for the nematocide treatments. Two to four trees were included in each treatment. Six rates were used varying from 2.5 to 40 gallons per acre. Nontreated trees were left as controls. An area of 100 square feet (1/435.6 of an acre) surrounding each tree was treated. Nemagon was injected into the soil at a depth of 12 inches on 12-inch centers. Three milliliters of material were released at each injection. At the high rate of 40 gallons per acre nondiluted Nemagon was used. The lower rates were obtained by appropriate dilution with kerosene. At the time of application, April 19, tree circumference measurements were recorded. Data on tree vigor and appearance were taken at irregular intervals during the summer.

On September 22, 1955, the following data were recorded: shoot length, tree trunk circumference, root-knot symptoms, Nemagon phytotoxicity to tree roots, and tree vigor (Table 1). Root-knot infestation was rated from zero (roots free from root-knot symptoms) to 5 (roots showing severe root-knot infestation). Practically no root-knot galls appeared on new root growth at the higher rates of Nemagon application (5-40 gallons per acre).

In Figure 1, roots from treated and nontreated trees are compared. As shown in Table 1, the nontreated tree roots examined were moderately to severely galled. Nemagon applied at the rate of 2.5 gallons per acre failed to give satisfactory root knot control. However, at the 5-gallon-per-acre rate there was good shoot growth, satisfactory root knot control, accompanied by fair to excellent tree vigor. The greatest increase in tree trunk circumference occurred at this rate, while the 8-gallon-per-acre rate indicated a slightly superior nematocidal effect. Tree growth and vigor were also good at the latter rate. The optimum treatment would appear to be between 5 and 8 gallons of Nemagon per acre. The 10 gallon-per-aore rate gave effective nematode control, but there was a suggestion of root poisoning, while the 20 gallon-per-acre rate resulted in definite tree stunting. At the rate of 40 gallons per acre there was extreme root injury resulting in death of the trees.

Some of the questions unanswered are: 1) How long will an effective nematocidal treatment protect a peach tree before re-infestation occurs? 2) What reduction in the soil nematode (root

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[1] The writers are indebted to the following: Dr. Robert Aycock (formerly Plant Pathologist at the Edisto Experiment Station) for cooperation with the initial peach root knot surveys; Drs. T. W. Graham, United States Department of Agriculture, and Q. L. Holdeman, Pee Dee Experiment Station, for screening soil samples in determining species of parasitic nematodes and for determination of root-knot nematode species (Meloidgyne arenaria); and Shell Chemical Company for supplying Nemagon used in these studies.

[2] Technical Contribution Number 256, South Carolina Agricultural Experiment Station.

[3] Associate Plant Pathologists, South Carolina Agricultural Experiment Station, Clemson, South Carolina.

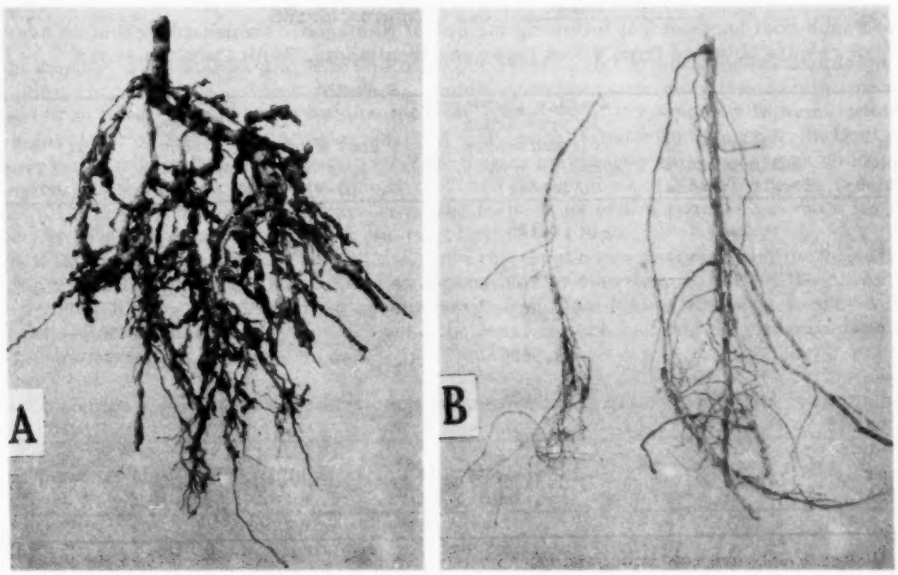

FIGURE 1. Comparison of peach roots from (a) Nontreated tree; (b) tree that received Nemagon at 10 gallons per acre. Note absence of root knot galls on roots from treated area. These roots (from treated area) developed subsequent to treatment on April 19, 1955. Photographs through courtesy of Clemson College Extension Service, Division of Motion Pictures and Photography, Clemson College.

Table 1. Peach root knot control following the use of Nemagon. Values represent an average of results obtained from 2 to 4 trees per treatment. South Carolina 1955.

Treatment: Nemagon per acre (gallons)	Average of maximum shoot length (Inches)	Average increase in tree trunk circumference (April 19 - Sept. 22) (Inches)	Root knot symptoms (0-5)[a]	Root appearance on Sept. 22 [b]	Tree vigor [b]
40.0	7.0	0.125	0	4	4
20.0	11.25	0.8125	0	2-3	3
10.0	32.75	1.75	0	2	2-3
8.0	50.5	1.5625	0	1-3	2
5.0	49.125	2.5625	0-1	1-2	1-3
2.5	47.25	2.375	1-2	1-2	2
None	24.0	1.3125	3-5	-	3

[a] 0 - No galling; 5 - Severe root knot galling.

[b] 1 - Excellent; 2 - Good; 3 - Poor to fair; 4 - Dying or dead.

knot) population occurs? 3) What dosage rate of Nemagon effectively kills root-knot nematodes within root galls? 4) Will Nemagon treatments made during fall or winter be equally nematocidal as treatments made during spring and summer? Additional experiments to answer the above mentioned questions are in progress, including a comparison of granular and liquid Nemagon.

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OCCURRENCE OF PLANT PARASITIC NEMATODES IN LOUISIANA SOILS

Max J. Fielding and John P. Hollis

In January 1955 Martin and Birchfield (2) published a list of nematodes associated with crop plants in Louisiana. They included, in addition to parasitic nematodes, other nematodes suspected as being parasitic. Two months later Atkins et al (1) reported 18 nematode species, either parasitic or suspected of being so, that were associated with rice roots in Louisiana and Texas. Since publication of these reports, further nematode surveys have been conducted in Louisiana by the writers and other members of the Department of Plant Pathology, Louisiana State University. These surveys have revealed large numbers of parasitic nematodes associated with the roots of the major crop plants grown in this State.

A total of 461 soil samples from 13 major crop plants was analyzed and the results are given in Table 1. The breakdown includes the number of samples, names of the parasitic nematodes for each crop plant, and the percentage of samples infested with a particular nematode.

Species of the genus Pratylenchus were the most common among the parasitic nematodes found in the Louisiana soils surveyed.

Table 1. Incidence of parasitic nematodes in soils around certain Louisiana crop plants.

Crop plant	Number of samples collected	Nematodes	Percent of samples infested
Alfalfa	26	Xiphinema americanum Cobb 1913	75
		Pratylenchus spp.	25
		Tylenchorhynchus spp.	25
		Trichodorus spp.	13
Citrus	25	Tylenchulus semi-penetrans Cobb 1913	95
		Pratylenchus spp.	65
		Helicotylenchus spp.	50
		Rotylenchulus sp.	12
		Paratylenchus sp.	8
		Xiphinema americanum	4
Clovers and lespedezas	36	Helicotylenchus spp.	56
		Pratylenchus spp.	44
		Tylenchorhynchus spp.	33
		Xiphinema americanum	22
		Trichodorus spp.	19
		Criconemoides sp.	15
		Hoplolaimus spp.	11
		Meloidogyne spp.*	8
		Paratylenchus sp.	7
Corn	53	Pratylenchus zeae Graham 1951	75
		Pratylenchus spp.	5
		Xiphinema americanum	40
		Helicotylenchus spp.	35
		Tylenchorhynchus spp.	25
		Trichodorus spp.	20
		Hoplolaimus coronatus Cobb 1923	
		Hoplolaimus sp.	9
		Criconemoides sp.	5
		Meloidogyne spp.*	3
Cotton	71	Pratylenchus leiocephalus Steiner 1949	
		Pratylenchus scribneri Steiner 1943	66
		Pratylenchus spp.	

Table 1. (Continued)

Crop plant	Number of samples collected	Nematodes	Percent of samples infested
Cotton (cont.)	71	Trichodorus sp.	66
		Meloidogyne spp.*	
		M. incognita acrita Chitwood 1949	65
		M. incognita (Kofoid & White 1919) Chitwood 1949	
		Helicotylenchus spp.	41
		Tylenchorhynchus spp.	30
		Xiphinema americanum	28
		Hoplolaimus spp.	10
		Paratylenchus sp.	7
		Ditylenchus spp.	3
		Rotylenchulus reniformis Linford & Oliveira 1940	(only on L.S.U. Hill Farm)
Pasture grasses	12	Pratylenchus spp.	80
		Xiphinema americanum	60
		Helicotylenchus spp.	50
		Trichodorus spp.	40
		Criconemoides sp.	20
		Meloidogyne spp.*	20
Pecans	18	Helicotylenchus spp.	50
		Tylenchorhynchus spp.	31
		Pratylenchus penetrans Cobb 1917	25
		Pratylenchus spp.	
		Xiphinema americanum	19
		Paratylenchus sp.	19
		Dolichodorus heterocephalus Cobb 1914	Grand Isle only
Rice	45	Tylenchorhynchus spp.	65
		Radopholus oryzae (v. Breda de Haan 1902) Thorne 1949	40
		Psilenchus hilarulus deMan 1921	18
		Helicotylenchus sp.	6
		Rotylenchus sp.	6
		Criconemoides sp.	4
		Hoplolaimus sp.	4
		Longidorus sp.	4
		Meloidogyne sp.*	2
		Ditylenchus sp.	2
Soybeans	12	Tylenchorhynchus spp.	60
		Pratylenchus leiocephalus	
		Pratylenchus spp.	60
		Xiphinema americanum	28
		Helicotylenchus spp.	28
		Hoplolaimus coronatus	
		Hoplolaimus sp.	14
		Meloidogyne spp.*	14
Strawberry	43	Tylenchorhynchus claytoni Steiner 1933	58
		Helicotylenchus spp.	47
		Meloidogyne hapla Chitwood 1949	
		Meloidogyne spp.*	42

Table 1. (Continued).

Crop plant	Number of samples collected	Nematodes	Percent of samples infested
Strawberry (cont.)	43	Pratylenchus leiocephalus	
		Pratylenchus spp.	10
		Criconemoides sp.	5
		Trichodorus sp.	5
Sugarcane	54	Tylenchorhynchus spp.	90
		Pratylenchus leiocephalus	
		Pratylenchus zeae	76
		Pratylenchus spp.	
		Helicotylenchus spp.	42
		Trichodorus spp.	42
		Meloidogyne spp.*	12
		Paratylenchus sp.	6
		Hoplolaimus spp.	6
		Xiphinema americanum	6
		Belonolaimus gracilis Steiner 1949	Grand Isle only
Sweetpotato	47	Helicotylenchus spp.	69
		Pratylenchus leiocephalus	
		Pratylenchus spp.	55
		Meloidogyne spp.*	33
		Xiphinema americanum	31
		Trichodorus spp.	24
		Tylenchorhynchus spp.	24
		Criconemoides sp.	10
		Paratylenchus sp.	10
Tomato	19	Meloidogyne incognita	
		Meloidogyne spp.*	74
		Pratylenchus spp.	16
		Tylenchorhynchus spp.	16
		Hoplolaimus coronatus	
		Hoplolaimus sp.	10
		Trichodorus sp.	10
		Helicotylenchus spp.	10
		Hemicyclophora sp.	5
		Paratylenchus sp.	5

* Only males and larvae observed.

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UNITED STATES DEPARTMENT OF AGRICULTURE, AGRICULTURAL RESEARCH SERVICE, HORTICULTURAL CROPS RESEARCH BRANCH; DEPARTMENT OF PLANT PATHOLOGY, LOUISIANA AGRICULTURAL EXPERIMENT STATION COOPERATING

SOME NEW RECORDS OF NEMATODE OCCURRENCE

THE ROOT-KNOT NEMATODE MELOIDOGYNE INCOGNITA ACRITA ON SUGARCANE IN LOUISIANA

By W. J. Martin and Max J. Fielding[1]

It has long been known that root-knot nematodes infect sugarcane[2, 3]. Since the revision of the genus to which they belong, however, there have been no reports as to the species occurring on this host[4]. In a recent collection of root-knot nematodes from sugarcane roots at Paincourtville, Louisiana, Meloidogyne incognita acrita Chitwood 1949 was found to be the species involved. Galls were extremely small and mature females were relatively few. Nevertheless, in the presence of the nematodes, root rot was prominent.

LOUISIANA STATE UNIVERSITY, AND UNITED STATES AGRICULTURAL RESEARCH SERVICE

[1] Plant Pathologist, Louisiana State University, and Associate Nematologist, Agricultural Research Service, United States Department of Agriculture, respectively.

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DISCOVERY OF THE SUGAR BEET NEMATODE IN THE MILTON-FREEWATER AREA OF OREGON

By Harold J. Jensen, Norton Taylor, and L. B. Loring[1]

The sugar beet nematode, Heterodera schachtii Schmidt 1871, occurs in Umatilla County, one of the principal sugar beet producing areas of Oregon. According to L. W. Lindsey of the Utah-Idaho Sugar Co. and growers in that area, effects of the nematode were first noticed about 8 years ago. Several fields in the Walla Walla Valley are known to be infested. The infestation of the Milton-Freewater area is apparently an extension of an older infestation of the Walla Walla area in Washington. This disease was first noticed in tracts having a history of vegetable crop production. Apparently some of the "tare dirt" was taken to these areas many years ago. Infestation has been spread by movement and disposal of "tare dirt". This pest has not been found in the Nyssa-Ontario area which produces most of the sugar beets in Oregon.

[1] Assistant Nematologist, Oregon Agricultural Experiment Station; Extension Agent, Umatilla County; and Plant Pathologist, Oregon State Department of Agriculture; respectively.

BARLEY STRIPE MOSAIC VIRUS IN DIFFERENT PARTS OF THE HEAD IN RESCUE AND ONAS SPRING WHEAT[1]

F. H. McNeal and M. M. Afanasiev[2]

Seed of Rescue and Onas spring wheat which was known to be infected with barley stripe mosaic virus was planted in the field at Bozeman, Montana, in 1955. Healthy plants were rogued during the summer and the diseased plants were pulled at harvest.

Heads from 20 plants in each variety were divided into top, middle, and bottom thirds. Each third was kept separate by plants, providing 60 samples for each variety. Twenty seeds from each sample were planted in flats in the greenhouse on December 28, 1955. Readings for mosaic were made on January 12, 1956, and again on January 23, 1956.

There appears to be no centralization of mosaic in any particular part of the head when both varieties are considered (Table 1). This is in agreement with results obtained by McKinney[3]. The pattern of mosaic in the heads of Onas is similar to that expected if disease were correlated with formation of the kernels, i. e., mosaic is highest in the early formed middle portion of the head. However, this same pattern does not occur in Rescue. It is of interest to note that even though the plants from which these samples were taken were infected with mosaic the average infection in the greenhouse plantings was only 52.6 and 35.7 percent for Rescue and Onas, respectively.

Highly significant positive correlations were obtained for mosaic between different parts of the head (Table 2). This is further indication that centralization of the disease did not occur, since as disease increased in one part of the head it also increased in other parts.

Table 1. Percentage barley stripe mosaic in different parts of the head in Rescue and Onas spring wheat.

Variety	Percent Barley Stripe Mosaic			
	Top	Middle	Bottom	Average
Rescue	58.4	54.2	45.3	52.6
Onas	32.3	41.7	33.0	35.7

Table 2. Correlation coefficients of barley stripe mosaic between different parts of the head in Rescue and Onas spring wheat.

Comparison	Correlation Coefficient r
Top vs. Middle	0.634**
Top vs. Bottom	0.663**
Middle vs. Bottom	0.560**

** Significant at P = 0.01

UNITED STATES DEPARTMENT OF AGRICULTURE AND THE MONTANA AGRICULTURAL EXPERIMENT STATION

[1] Joint contribution of the United States Department of Agriculture and the Montana Agricultural Experiment Station, Paper No. 376 Journal Series.

[2] Respectively, Agronomist, Field Crops Research Branch, Agricultural Research Service, United States Department of Agriculture, and Plant Pathologist, Botany and Bacteriology Department, Montana Agricultural Experiment Station.

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FOLIAGE SYMPTOMS ON SWEET CHERRY INFECTED WITH THE LITTLE-CHERRY-TYPE VIRUS OBTAINED FROM KWANZAN AND SHIRO-FUGEN ORIENTAL FLOWERING CHERRIES.

E. L. Reeves and Philip W. Cheney[1]

The occurrence of a little-cherry-type virus in clones of normal-appearing Kwanzan and Shiro-fugen oriental flowering cherries was recently reported[2]. These clones have been widely distributed and are being extensively employed as test plant material to indicate the presence of ring spot viruses in stone fruits; therefore, one purpose of the preliminary paper was to alert other workers using flowering cherries of the presence of the little-cherry-type virus. In the original report[2] under the heading "Work in Washington" it was stated with reference to infected Bing and Lambert sweet cherry trees that "Symptoms were confined to fruits; the growth and foliage of all trees involved were apparently normal." It is now known that during the late summer and fall recognizable foliage symptoms develop on certain varieties of sweet cherries infected with the little-cherry-type virus, and it is the purpose of this paper to report and describe these symptoms.

During the growing season of 1955 foliage on infected trees appeared normal until early September. At that time the older leaves began to develop what appeared to be early autumnal yellow and bronze coloration. As the season progressed these leaves developed more red and Bing, Van, and Burbank leaves became reddish-bronzed. Also, as the season progressed, coloration of leaves advanced from the base of shoots toward the growing points, until by late October only the terminals of affected Bing trees were comparable to those of uninoculated (check) trees.

On affected Bing trees the first difference in coloration appears as a bronzing of the interveinal tissue on the upper surface of older leaves, the areas along the veins and basal portion of the leaves remaining mostly green. As the season progresses, the bronzing becomes a brighter red and the green areas along the veins turn yellow. Thus, by mid-October the upper surface of the leaf presents a streaked red and yellow appearance. By this time some red coloration will show also in the interveinal areas on the lower leaf surface. Figure 1 shows leaves from a Bing tree photographed in mid-September, representative of 15 to 20 percent of the foliage on the older half of current season's growth. By late October nearly all the leaves on an affected tree are bronzed and there is considerably more red pigmentation in leaves that changed color first.

During the late summer and fall of 1955, leaf symptoms were observed on 244 infected sweet cherry trees in the experimental plots at Wenatchee, Washington. This consisted of 135 Bing trees 1 to 5 years old, 86 Bing budlings all propagated from known infected trees, and 23 experimentally infected trees (2 to 8 years old) of Lambert, Van, Napoleon, Burbank, Black Tartarian, Seneca, Spaulding, Ebony, and Chapman. Some of the varieties on which symptoms were observed in 1955 showed less color development than occurred on Bing, whereas others showed considerably more red color. Lambert developed the least coloration. By late October, diseased Lambert trees had foliage coloration somewhat comparable to that expressed by infected Bing trees in mid-September. The under surface of Lambert leaves showed practically no change in color prior to the time of normal autumnal coloration. Infected trees of the Van variety developed more reddening of the foliage than did Bing; some leaves were nearly scarlet with little or no green. The under surface of Van leaves developed some yellow along the veins and pink to red in the interveinal areas. Some varieties developed less variation in foliage color than Bing; Chapman had more brownish color in the interveinal areas of the upper leaf surfaces; Black Tartarian developed more yellow than Bing, particularly along the veins; and Burbank showed more general red coloration.

Foliage symptoms on sweet cherry appear to be a definite feature of the little-cherry-type virus obtained from Kwanzan and Shiro-fugen flowering cherries and may prove to be a quick and valuable diagnostic tool. It should be pointed out that the symptoms described were observed during 1955 only; however, in September the 221 infected Bing trees could easily be

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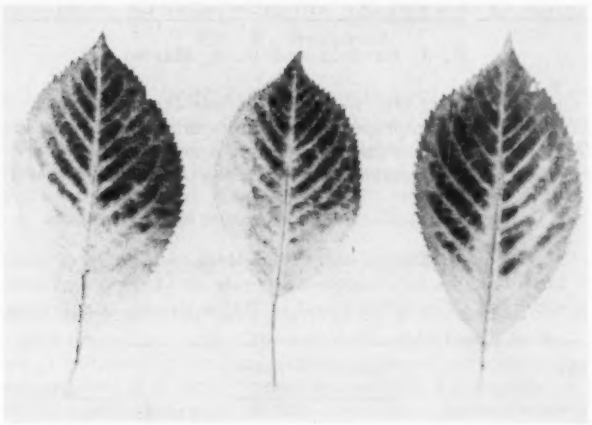

FIGURE 1. Leaves from a Bing cherry tree infected with a little-cherry-type virus originally found as a latent in certain clones of Kwanzan and Shiro-fugen flowering cherry. (Photographed with Eastman Wratten B filter No. 58.) Interveinal areas are reddish-bronze; light areas along the veins and basal portion of leaves are mostly green without red pigmentation.

distinguished by the colored leaves from the uninoculated check Bing trees and from other sweet cherry trees in the experimental plots. It is recognized that adverse growing conditions, weather, and other factors can cause coloration in leaves of sweet cherry, but in this case only the trees known to have the virus were visibly affected.

Relatively moderate temperatures with no frost during October 1955 probably favored the development of foliage symptoms. During seasons when colder weather occurs earlier in October, it is possible that no great difference would be apparent in the foliage of normal and infected Lambert trees. However, differences in foliage coloration between normal and infected trees should be apparent on the other varieties mentioned during September and into October, until frost occurs.

Three of the 5 infected Van cherry trees involved were inoculated the last week of July 1955 and showed considerably more red coloration of the foliage than Bing. Since only 2 1/2 months elapsed between the time of inoculation and a definite reddening of the foliage the Van variety gives promise of being a quick diagnostic host.

Bing cherry trees affected with Western-x virus and showing characteristic fruit symptoms showed none of the leaf colorations described for Bing trees affected with the little-cherry-type virus obtained from flowering cherries. Colored foliation thus serves to differentiate the two diseases, which might be confused on the basis of fruit symptoms.

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INCIDENCE OF INTERNAL CORK OF SWEETPOTATO REDUCED AFTER FOLIAR APPLICATIONS OF INSECTICIDES

E. J. Kantack and W. J. Martin

Both percentage and severity of internal cork lesions in sweetpotato roots were markedly reduced in a randomized block design experiment comprising cork-affected and cork-free planting stocks (Table 1). Differences did not become apparent until after 4 1/2 months storage at 70° to 75° F. Cork-free planting stocks were divided into treated and untreated plots.

Table 1. Mean[a] percentages and mean disease indices of internal cork lesions in sweetpotato roots at harvest and after storage. From field test at Baton Rouge, Louisiana, 1955.

Treatments	Percent of cork-affected roots		Disease index	
	At Harvest	After Storage	At Harvest	After Storage
Cork-affected planting stock	42.3	91.0	25.9	77.0
Cork-free planting stock	5.2	54.8	3.2	38.3
Cork-free planting stock[b]	2.7	31.3	1.3	18.3
LSD at 5%	5.94	15.74	4.28	14.05
LSD at 1%	8.47	22.37	6.09	19.97

[a] Each mean derived from a one-bushel sample of US #1 sweetpotato roots sliced and examined in each of six replications.

[b] Treated twice weekly with 10 pounds of 10% DDT dust per acre during entire growing season. American Cyanamid Compound 12008 was also applied at 2 pounds per acre once weekly in a water-spray formulation from from mid-June to mid-July.

Treatment consisted of bi-weekly dusting during the entire growing season with 10% DDT dust at 10 pounds per acre. In addition, 2 pounds per acre of a systemically active chemical, American Cyanamid Compound 12008, was applied to the foliage once weekly from mid-June to mid-July. Insect populations determined weekly during the latter portion of the growing season showed a considerable reduction in numbers of foliage feeding insects present in plots treated with insecticides. Greatest reductions at this time appeared to be among species of leafhoppers, particularly Empoasca solana DeL., as well as the flea beetle, Chaetocnema confinis Crotch, and the banded cucumber beetle, Diabrotica balteata Lec.

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CHEMICAL TREATMENT OF POTATO SEED IN CONNECTICUT 1955

Paul E. Waggoner[1]

Bacteria and fungi frequently cause decay of potato seed. Bonde's[2] demonstration that streptomycin protected cut tubers from blackleg bacteria, Erwinia atroseptica, has awakened new interest in the control of bacterial decay by chemical treatment of seed. Consequently, we undertook experiments to, 1) find a fungicide compatible with the non-fungicidal streptomycin, and 2) determine whether seed treatment would increase stands, vine growth, or yields under the conditions of commercial practice in Connecticut.

LABORATORY TESTS OF COMPATIBILITY

The effect of captan and rimocidin upon the toxicity of streptomycin to soft rot bacteria, Erwinia carotovora, was tested in vitro. The bacteria, furnished by Dr. Bernard Friedman, were grown for 2 days in nutrient broth on a shaker. One ml of this inoculum was then added to 9 ml of broth containing 0 to 2.5 ppm streptomycin from Agrimycin 100, and either 62 ppm captan from a 50% active wettable powder or 125 ppm pure rimocidin furnished by Chas. Pfizer & Co., Inc. After 3 days the number of bacteria was estimated by the optical density of the cultures at 525 mμ. No great change in the toxicity of streptomycin was produced by either of these two widely different fungicides.

The effect of streptomycin upon the toxicity of widely different fungicides to a dry rot fungus, Fusarium sambucinum f. 6, was tested in vitro. The fungus, furnished by Dr. R. C. Cetas, was grown for 6 days on potato dextrose agar. One ml of a spore suspension was added to 9 ml of nutrient broth containing 3% glucose and either no streptomycin or 125 ppm. To the broth in separate tubes one of five concentrations of captan (from 0 to 62 ppm), of rimocidin (from 0 to 90 ppm), or of nabam (0 to 125 ppm from Dithane D-14) was added. After 5 days mat growth in the tubes was measured. Streptomycin did not decrease the toxicity of any fungicide.

These experiments showed that streptomycin and a variety of fungicides could be combined without loss of fungicidal or bacterial effectiveness in vitro. It remained to be seen whether this result would apply to the inoculation of cut tubers also.

The effect of fungicides upon the toxicity of streptomycin to bacteria growing on potato slices was tested. Eight sterile slices of Green Mountain tubers were dipped in streptomycin and fungicides dissolved or suspended together in water. The slices were then drained, and inoculated by spraying with a 2-day old culture of E. carotovora. The fungicides tested were 700 ppm dichlone from Phygon XL, 1250 ppm captan, 100 and 1000 ppm rimocidin, nabam at 790 ppm, and the related zineb and maneb from Dithane at the same molarity as nabam. After 3 days at room temperature slices that had not been dipped in streptomycin were consistently 100 percent macerated, whereas slices that had been dipped in 100 ppm streptomycin, with or without one of the fungicides in the same dip, were all sound.

The effect of streptomycin upon the action of fungicides on Fusarium growing on potatoes was next tested. Eight potato slices were dipped in each of the fungicides with and without streptomycin. In this experiment dichlone was used at 1250 ppm. The slices were then sprayed with spores of Fusarium and incubated for 9 days at 45° F. The percentage of the surface of the slices covered by mycelium was estimated. The means are given in Table 1. Percentages were mostly in the range from 20 to 80 and were analyzed without transformation. The low percentages for 1000 ppm rimocidin and 1250 ppm dichlone were not included in the analysis. Streptomycin significantly increased the growth of Fusarium on the slices. Captan 1250 ppm alone reduced the growth of Fusarium, but with streptomycin it did not prevent the increase. Rimocidin at 1000 ppm prevented growth in the presence of streptomycin but at 100 ppm the increase in growth caused by streptomycin was evident. The effect of rimocidin at 1000 ppm must have been inhibition of the fungus rather than prevention of the increase in susceptibility of the tuber. Dichlone at 1250 ppm also did not permit much growth of Fusarium. The diethyl dithiocarbamate salts were not fungicidal in this test; in fact, combining streptomycin and either nabam or maneb gave some increase in the mean growth of Fusarium.

[1] The author wishes to thank Miss Phyllis Nettleton for her technical assistance.

[2] Bonde, R. 1953. Preliminary studies on the control of bacterial decay of the potato with antibiotics. Amer. Pot. Jour. 30: 143-147.

Table 1. Growth of Fusarium after 9 days at 45° F on potato tuber slices, untreated and treated with indicated fungicides with and without streptomycin and with streptomycin alone. Connecticut experiments.

Fungicide ppm	Percent of tuber slice covered with mycelium	
	Without streptomycin	Streptomycin 100 ppm
None	42[a]	71
Dichlone 1250	1	6
Captan 1250	20	30
Rimocidin		
100	29	64
1000	0	0
Nabam 790	31	82
Zineb 850	62	66
Maneb 730	60	82
Mean[b]	41	66

[a] Means of 8: LSD = 22.
[b] Means of 48: LSD = 9.

FIELD EXPERIMENTS

Five field experiments were run under a variety of conditions. The laboratory tests of compatibility had not yet been completed and could not be taken into account. Seed was dipped in water, 100 ppm streptomycin, 790 ppm nabam, or streptomycin plus nabam. The weather was extremely dry until mid-August after which it was extremely wet.

In the first experiment whole foundation Katahdin seed tubers were planted immediately after treatment in a poorly drained section of upland. No consistent differences in emergence or vigor of vines were seen, nor any consistent treatment differences in yield, grade, or decay.

The second experiment was run with cut, home-grown Katahdin seed stored 6 days at 45° F before planting under similar soil conditions. Once again no differences in emergence, vine vigor, yield, or tuber decay were observed.

In the third experiment cut certified Green Mountain seed overgrown with bacteria and fungi stored 4 days at 50° to 60° F after treatment, were planted in well-drained upland soil. No treatment differences appeared.

In the fourth and fifth experiments cut certified Katahdin seed were stored 11 to 12 days at 45° F before planting in heavy, poorly drained river bottom land soils. The treated plants emerged at about the same rate as the checks. In June the plants were ranked for vigor without knowing which plants received the treatments. Seed treated with streptomycin, with or without nabam, had produced more vigorous plants. The differences, based on two experiments of 5 replicates each, were significant at the 20% level. These two experiments were destroyed by flood in mid-August.

CONCLUSIONS

A wide range of fungicides had no effect upon the bactericidal ability of streptomycin in vitro or on potato slices. Streptomycin did not increase the growth of Fusarium in vitro, but

did increase the susceptibility of potato slices to the fungus. Captan, dichlone, and rimocidin were capable of reducing the growth of the fungus on tuber slices in the presence or absence of streptomycin. Similar results have been obtained by Dr. Avery Rich with captan and dichlone (personal communication).

The failure of streptomycin to increase emergence or yields indicated that bacterial decay was not a problem in Connecticut upland in 1955. Its failure to decrease emergence or yields indicated that fungal decay was also unimportant. Possibly streptomycin treatment was beneficial to lowland potatoes as indicated by an improvement in vine growth similar to that observed by Bonde[3].

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CHEMOTHERAPY OF LETTUCE BIG-VEIN

Saul Rich

Summary

Healthy lettuce seedlings were treated with various chemotherapeutants prior to setting the plants out in a field infested with lettuce big-vein virus.

The following treatments significantly reduced the amount of big-vein subsequently appearing in the treated plants: napthaleneacetic acid at 50 and 100 ppm, 2,4,6-trichlorophenoxyacetic acid at 50 ppm, indoleacetic acid at 50 ppm, calcium chloride at 1000 ppm, and zinc sulfate at 250 ppm. The plants treated with the first three treatments had significantly less disease than those treated with the last three treatments. CC 1182 and captan treatments were not effective.

The plants were significantly stunted by naphthaleneacetic acid at 50 and 100 ppm, and by CC 1182 at 100 ppm. Zinc sulfate significantly increased the fresh weight of the treated plants at harvest over the fresh weight of the checks.

This technique shows promise as a practical method for reducing losses caused by lettuce big-vein.

Big-vein of lettuce is a soil-borne virus disease (4,6) which is present in most commercial lettuce fields in Connecticut. Infected plants are stunted, slow to head, and show the enlarged, clear veins which give the disease its name.

Probably the most serious loss from big-vein is the failure of infected plants to mature in time for the high price of the early market. The big-vein symptoms are most pronounced in cool weather. With the coming of warmer weather the plants again begin to grow, but by this time they are too late for the early market.

Soil sterilization with chloropicrin, formaldehyde, or steam can rid the soil of active virus (1,4) but the treatments are fairly expensive and do not insure against recontamination. Our approach to the problem was to seek a material which could be watered on the seedlings before transplanting and which would make the plants resistant to big-vein during the critical early stages of growth.

METHODS AND MATERIALS

The materials tested for this purpose were some that had been shown by other workers to be effective chemotherapeutants against other diseases. These were the growth regulators (2, 3) naphthaleneacetic acid (NAA), indoleacetic acid (IAA), 2,4,6-trichlorophenoxyacetic acid (2,4,6-T), all three at 50 and 100 ppm, and 2-(4-chloro-3,5 xylyloxy)ethanol (CC 1182) at 100 ppm. Calcium chloride at 1000 ppm, and zinc sulfate at 250 ppm shown by E. M. Stoddard (5) to be effective against cherry X-disease were included. In addition the fungicide captan was tested at 2500 ppm.

Flats of Penn Lake lettuce growing in steam sterilized soil received the treatments on April 1, 5, 9, and 13. The materials were watered on the flats at the rate of a pint per flat on each treatment date. The control plants were watered with one pint of tap water each time. The plants were set in big-vein infested soil on April 15 in a 5 x 11 Youden square, 10 plants per plot. Disease readings were taken on June 1. The lettuce was cut on June 17, and each head was weighed as soon as it was harvested. The disease and yield data are given in Table 1.

RESULTS AND DISCUSSION

Based on the amount of disease incidence, the treatments could be divided into three groups: 1) The best treatments, NAA at both 50 and 100 ppm, and 2,4,6-T at 50 ppm were significantly better than all the other treatments; 2) Calcium chloride and zinc sulfate were significantly better than the check; 3) The rest of the treatments did not differ significantly from the check.

NAA at both concentrations and CC 1182 significantly stunted the treated plants. Only zinc sulfate significantly increased the fresh weight of the treated plants.

This experiment demonstrated that the treatment prior to transplanting can be used to make lettuce seedlings resistant to the big-vein virus. Whether these treatments prevented infection or merely masked symptoms cannot be told from the data presented here. Regardless

Table 1. Big-vein incidence and yields for lettuce plants pre-treated with chemotherapeutants.

Material	Conc. ppm	Ave. number of diseased plants per plot	Ave. fresh weight of heads per plot (grams)
Naphthaleneacetic acid	50	2.6 (a)	518 (b)
" "	100	2.8 (a)	442 (b)
Indoleacetic acid	50	5.8 (a)	689
" "	100	7.8	652
2,4,6-Trichlorophenoxyacetic acid	50	3.6 (a)	737
"	100	7.0	590
CC 1182	100	6.9	394 (b)
Captan	2500	7.1	779
Calcium chloride	1000	6.4 (a)	709
Zinc sulfate	250	6.0 (a)	871 (c)
Check	-	8.6	714

L.S.D. at 5% level for disease data = 2.2
L.S.D. at 5% level for yield data = 133 grams.

[a] = Significantly less disease than check.
[b] = Significantly lighter than check.
[c] = Significantly heavier than check.

of which mode of action was operative, the method should be of use to the grower.

The protection afforded by NAA cannot be a result of stunting, because the treatment which stunted the plants most severely, i.e., CC 1182, did not reduce big-vein symptoms significantly.

The increased yield with zinc sulfate may be caused by either of two factors: 1) the correction of an otherwise undetected zinc deficiency, or 2) the preferential alleviation of the stunting effect of the virus.

The three most promising treatments for practical use are IAA at 50 ppm, 2,4,6-T at 50 ppm, and zinc sulfate at 250 ppm.

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SEED TREATMENTS TO PROTECT CORN SEEDLINGS AGAINST STEWART'S WILT

Saul Rich

Summary

Seed soaking and dry seed treatments of corn seed were tried in an attempt to make corn seedlings resistant to Stewart's wilt. The treated seeds were planted in the greenhouse, and the resulting seedlings inoculated with broth suspensions of Bacterium stewartii. The following treatments significantly reduced the severity of wilt symptoms: seed soaks of 2,4,6-trichlorophenoxyacetic acid, Crag 1 herbicide, captan, Terramycin, and streptomycin; and a dry seed treatment of HD 160.

Stewart's wilt (Bacterium stewartii E.F. Sm.) can destroy whole fields of corn seedlings if the young plants are infected very early. If the seedlings could be protected through the very early stages, the plants would make a crop even though later they became diseased. Seed treatments that would make the emerging seedlings resistant to wilt would be cheap, easy to use, and would offer protection when it is most needed. Any promising materials could also be tried as foliage sprays after the seedlings had begun to grow (6).

The materials tested for this purpose were antibiotics, growth regulators, and compounds which had shown chemotherapeutic activity in other studies. The antibiotics tried were penicillin, streptomycin and Terramycin. The growth regulators were maleic hydrazide, indoleacetic acid, 2,4-D, N-phenyl isopropylcarbamate (IPC), N-(3-chlorophenyl)isopropylcarbamate (chloro IPC), β-napthoxyacetic acid, naphthaleneacetic acid, sodium 2,4-dichlorophenoxyethyl sulfate (Crag1), pentachlorophenoxyacetic acid, 2,4,6-trichlorophenoxyacetic acid (2,4,6-T), and pentachloroisobutyric acid. Certain of these growth-regulators have already been demonstrated to make plants resistant to diseases (1, 2, 5). The miscellaneous materials chosen had previously been demonstrated by others (4,7) to act as chemotherapeutants against other diseases. These were glucose, benzoic acid, and salicylic acid. Isonicotinic acid hydrazide was included as a possible bactericide. Captan was also tried.

Twenty-five seeds of North Star sweet corn were used for each treatment. The seeds were soaked overnight in 25 cc of a dilution of the test material. Water soluble materials were dissolved directly in water, while the less soluble compounds were dissolved first in 1 ml of acetone before being taken up in water. After the seeds had soaked overnight, they were blotted and then planted immediately in plant bands filled with soil, 5 seeds per band. Control seeds were soaked in water overnight before planting. The plant bands, arranged in a 21 x 5 Youden square, were kept in the greenhouse at 80° F. When the seedlings showed two true leaves, they were inoculated by hypodermic syringe with a 72 hr. broth culture of Bacterium stewartii. Leaf symptoms were read about a month after inoculation. Five disease grades were used: 0 = no disease, 1 = slight spotting, 2 = spots and chlorotic streaks, 3 = necrotic streaks, 4 = death of youngest leaves. The treatments, dilutions, and data for the first experiment are given in Table 1.

Four treatments were promising. These were streptomycin at 100 ppm, Terramycin at 100 ppm, captan at 1000 ppm, and 2,4, 6-trichlorophenoxyacetic acid at 50 ppm. These were the only four treatments significantly better than the inoculated check. Crag 1 at 50 ppm was the fifth best treatment, and was considered worthy of another trial.

The second experiment included the 5 materials that looked best in the first experiment. Streptomycin and Terramycin were tried at 4 dosages: 100, 200, 400 and 800 ppm. Captan was tried at 1000, 2000, and 4000 ppm. Crag 1 and 2,4,6-T were tried at 50, 100, 200, and 400 ppm. The experiment was carried out in exactly the same manner as the first trial. The results are given in Table 2.

In the second trial, conditions for infection and disease severity were more favorable than during the first trial. This is shown by the general increase in percentage of seedlings showing symptoms, and by the severity of disease in the inoculated check. Much higher dosages of the two antibiotics were required in the second trial than in the first trial to reduce symptom severity significantly. Terramycin at 800 ppm prevented the emergence of seedlings. The results with captan were erratic. All concentrations of the two growth regulators reduced wilt severity significantly. The Crag 1 data indicated that dosages higher than 50 ppm were increasingly less effective in protecting the seedlings against wilt. The dosage series of 2,4,6-T

Table 1. Incidence of Stewart's wilt in seedlings growing from seeds soaked in various antibiotics, growth regulators or chemotherapeutants.

Material	Conc. ppm	Average severity of wilt
Penicillin	100	1.24
Streptomycin	100	0.83 (a)
Terramycin	100	0.82 (a)
Isonicotinic acid hydrazide	100	1.24
Captan	1000	1.00 (a)
Glucose	500	1.41
Benzoic acid	1000	1.54
Salicylic acid	250	1.61
Pentachloroisobutyric acid	50	2.25
Pentachlorophenoxyacetic acid	50	2.29
2,4,6-T	50	0.76 (a)
Indoleacetic acid	50	1.83
2,4-D	50	1.54
I.P.C.	50	2.13
Chloro I.P.C.	50	2.33
β-Naphthoxyacetic acid	50	1.42
Naphthaleneacetic acid	50	2.88
Crag 1	50	1.16
Maleic hydrazide	500	-- (b)
Uninoculated check	----	0 (a)
Inoculated check	----	2.48

L.S.D. at 5% level = 1.45

(a) = Significantly less than inoculated check.

(b) = Prevented seedling emergence.

Table 2. Incidence of Stewart's wilt in corn seedlings growing from seeds soaked in various concentrations of materials which showed promise in the first experiment.

Material	Conc. ppm	Average severity of disease
Streptomycin	100	2.12
"	200	2.32
"	400	2.08
"	800	1.67 (a)
Terramycin	100	2.73
"	200	2.14
"	400	1.81 (a)
"	800	—
Captan	1000	2.17
"	2000	1.78 (a)
"	4000	2.45
2,4,6-T	50	1.52 (a)
"	100	1.70 (a)
"	200	1.60 (a)
"	400	1.62 (a)
Crag 1	50	1.52 (a)
"	100	1.60 (a)
"	200	1.76 (a)
"	400	1.83 (a)
Check	—	2.78

L.S.D. at 5% level = 0.90.

(a) = Significantly less than check.

Table 3. Incidence of Stewart's wilt in corn seedlings growing from seeds soaked or dry treated with chemotherapeutants and an antibiotic.

Material	Conc. ppm	Type of Treatment	Average severity of symptoms
Streptomycin	100	Soak	1.09 (a)
Captan	1000	"	1.60
2,4,6-T	50	"	1.32
HD-160	500	"	1.27
Acetone	2000	"	1.52
Check	—	"	1.44
Streptomycin		Dry	-- (b)
Captan		"	1.44
2,4,6-T		"	1.59
HD-160		"	0.76 (a)
Check		"	2.00

L.S.D. at 5% level = 0.81.

(a) = Significantly less than dry check.
(b) = Seedlings failed to emerge.

showed no trends.

A third experiment was tried to see if some of these materials would be effective as dry seed treatments. The materials tried were 2,4,6-T, streptomycin, captan, and HD-160. HD-160 is sodium S-(2-benzothiazolyl)thioglycolate, reported by Dimond and Davis (3) to have chemotherapeutic activity. The materials were compared as seed soaks and as dry treatments. The concentrations used for soaks are given along with the disease data in Table 3. The dry treatment consisted of shaking 25 seeds with 1/2 gram of the test material, then planting the seeds immediately after treating. All other details of this experiment are the same as for the first experiment, except that the seeds were planted in sand instead of soil.

The severity of disease symptoms was much less in this experiment than in the other two. Only the symptom severity of the streptomycin soak treatment and the HD-160 dry treatment were significantly less than the dry check. The dry streptomycin treatment prevented seedling emergence.

Apparently corn seedlings can be made resistant to Stewart's wilt by treating seeds with antibiotics and other chemotherapeutants. Just how long after emergence resistance remains is yet to be explored. There are probably other materials or other formulations of the materials reported here which may be much more effective in making corn seedlings resistant.

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EFFECTS OF ANTIBIOTIC DIP TREATMENTS ON CARNATIONS

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SUMMARY

Phytotoxic effects were obtained on carnation cuttings following dip treatments with Terramycin and Streptomycin S.

Failure of callus tissue formation and poor rooting characterized the phytotoxic effects.

Phytotoxicity of antibiotics has been reported by Wright (3) and Pramer and Wright (1). Most of the previous reports were concerned with seeds or seedlings in various substrates. Robinson et al (2) reported phytotoxicity in chrysanthemum cuttings from dip treatments of streptomycin at concentrations above 300 ppm and oxytetracycline at 150 ppm and above. Root development of chrysanthemums was better at the lower concentrations of antibiotic used. This report describes results with antibiotics used as dip treatments of carnations.

MATERIALS AND METHODS

The antibiotics tested were Terramycin, Streptomycin S., Thiolutin, Rimocidin, Fumagillin, Erythromycin, and Procaine Penicillin G. All were crystalline preparations and those insoluble in water were first dissolved in recommended solvents. Aqueous solutions containing antibiotic concentrations of 1, 3, 5, 10, 20, 30, 60, 120 ppm were prepared from stock solutions. Fresh knife trimmed cuttings of Pink Sim carnations were immersed for 8 hours at room temperature. Each treatment contained 16 cuttings and was replicated three times. Following treatment, the cuttings were struck into a sterilized propagating medium of vermiculite, uniformly watered, and maintained at a constant propagating temperature of 60° F. Observations were made after 30 days. The measure of root formation was determined by judging the condition of cuttings for use in transplanting.

RESULTS AND DISCUSSION

The results are presented in Table 1. The percentage of well rooted cuttings was markedly influenced by the Terramycin and Streptomycin S. treatments. No stimulation of better rooting due to antibiotic treatments was observed.

The greatest toxicity was in the Streptomycin S. and Terramycin treatments, at 60 and 120 ppm, and 20 ppm and above, respectively. The contrasting characteristics of the phytotoxicity were that the Terramycin treatment affected the callus and root formation. The cuttings failing to root lacked defined callus tissue.

The cuttings of the Streptomycin treatments did not collapse but showed symptoms of wilting and some blanching. At 20, 30, and 60 ppm the cuttings were almost like those at the lower concentrations except that they lacked root development in spite of callus tissue formation. The cuttings at 120 ppm were characterized by a brown discoloration and shrinkage of the basal ends of the cuttings.

It is surmised that the phytotoxic dosages affected the hormonal balance, influencing callus tissue and subsequent root formation.

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[1] Assistant Professor of Botany, Waltham Field Station. Contribution No. 1044 of the University of Massachusetts College of Agriculture Experiment Station, Amherst, Massachusetts.

Table 1. The Effect of Various Antibiotics in Rooting of Pink Sim Carnation Cuttings.

Treatment	Antibiotic and type of rooting response															
PPM	Terramycin				Streptomycin S.				Thiolutin				Rimocidin			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1	4	3	1	9	4	.7	1.3	10.3	1.7	1	1	12	3.7	4	1	7.3
3	2	.7	1.7	11	4.3	2.3	1.3	10.7	2	1.3	0	12.7	.7	1.3	.7	13
5	1.7	.7	1.7	12.3	2.7	.7	1.7	10.7	1	0	.3	14.7	2	1.7	1	11.3
10	1	.7	1.7	12.3	4.7	2.3	2.7	6.3	1.3	.7	0	14	.7	.3	0	14.7
20	1.3	1.3	.3	12.7	14	1.3	0	.7	.7	.3	.3	15	.7	.7	1	13.7
30	2.3	1.3	1.7	10.7	15.7	.3	0	0	1.3	.3	1	13.3	1.7	1	.3	13
60	6.7	4.7	1.3	2.3	16	0	0	0	2	1	1	11.3	.7	0	0	15.3
120	15.7	.3	0	0	16	0	0	0	.7	0	1	14.7	2	.3	.7	13
NONE	0	0	.3	15.7	0	0	0	16	0	0	0	16	0	0	0	16

Table 1. (continued)

Treatment	Antibiotic and type of rooting response											
	Fumagillin				Erythromycin				P. Penicillin G.			
PPM	1	2	3	4	1	2	3	4	1	2	3	4
1	3	1.3	.3	11.3	3.7	2.3	1	8	2	.7	.3	12.7
3	1.7	1	1	12	1	1	.3	13	2.7	1	.7	11.7
5	1.7	0	0	14.3	2	1.3	1.3	11.7	1	1	.7	13.3
10	1	.3	0	14.7	2	0	0	14	1.7	.7	.7	12.7
20	3	.3	.3	9.7	3.7	1	.3	11	2.7	0	0	13.7
30	.7	.3	.7	14.3	.7	0	.3	15	.7	.3	.3	14.7
60	3.7	.3	1.7	10.7	1.7	0	0	14.3	2	0	.7	13.7
120	4	1	1.3	12.3	1.3	0	.3	11	2.3	.7	0	13.3
NONE	0	.3	.3	15.4	.3	0	1	14.7	0	0	0	16

Figures represent averages of 3 replications

Class 1 - No rooting
2 - Slightly rooted, unsatisfactory for transplanting
3 - Medium rooted, small root, but satisfactory for transplanting
4 - Well rooted, satisfactory for transplanting

DEPARTMENT OF BOTANY, UNIVERSITY OF MASSACHUSETTS, WALTHAM FIELD STATION, WALTHAM, MASSACHUSETTS

WEATHER FLECK ON NICOTIANA TABACUM

L. G. Burk and H. E. Heggestad

Summary

During 1955 weather fleck, a physiologic leaf spot disease, occurred with great severity in experimental tobacco plantings at Beltsville, Maryland. Observations suggest that weather fleck results from cellular breakdown conditioned by environmental factors. Variable amounts of weather fleck developed about mid-July in a replicated test consisting of Burley 11A, Burley 2, Virginia Gold, Maryland Medium and 12 reciprocal hybrids among the 4 varieties. Maryland Medium, the most resistant variety, imparted a high level of resistance to its hybrids.

In recent years a leaf spot condition, commonly referred to as weather fleck, has become a serious problem in the production of cigar wrapper tobacco in the New England States. Monetary losses to the cigar industry in 1955 due to weather fleck have been estimated at $1,000,000.

During 1955, studies of weather fleck were made following severe outbreaks of the leaf spot in experimental tobacco plantings at the Plant Industry Station, Beltsville, Maryland. Standard varieties and their F_1 hybrids, as well as other breeding lines, showed varying degrees of injury and differences in symptom expression.

A literature search uncovered four articles which may have a bearing on weather fleck. The descriptions of non-parasitic leaf-spots by Anderson (1) do not closely resemble weather fleck; however, his statement that they "... are prone to break out suddenly a few days after hard rains" as has been observed for weather fleck, suggests that there may be some relationship. The descriptions of non-parasitic leaf-spots by Johnson (2) (3) are in close agreement with the authors' observations, although photographs presented by Johnson (3) do not adequately represent the leaf spot discussed in this paper. Johnson (2) discussed the causal effects of environment and concluded that control is dependent on use of resistant varieties. Smith (4) reported a leaf spot which he believed to be due to a hereditary defect of certain hybrids. A comparison of symptoms seems to indicate that weather fleck and the leaf spot described by Smith represent different non-parasitic leaf spots. Typical weather fleck is characterized by predominantly smaller and more numerous lesions and absence of vein necrosis. It is quite possible, however, that weather fleck and other somewhat different appearing non-parasitic leaf spots are produced by the same or related factors.

The objective of this paper is to describe in some detail the leaf spot referred to as weather fleck which occurred in tobacco plantings at Beltsville, environmental factors associated with its appearance, and variability in leaf spot occurrence observed in an intervarietal test.

Symptoms and Observations

In 1955, environmental factors favorable for the expression of weather fleck produced four distinct outbreaks of the leaf spot. Observations indicated that rains and especially prolonged periods of high humidity favored the formation of weather fleck leaf lesions. During such moist periods plants made rapid growth and leaves became slightly chlorotic and very succulent. Matured basal leaves became marked by many closely aggregated, irregular tan-to-brown flecks that, with age, became white (Fig. 1A). Little change in color, shape or size took place 8 to 10 days following initial appearance. Some spots were as large as 2 mm in diameter. Large spots and necrotic areas which resulted from the coalescence of several smaller lesions often became torn, giving a shot hole effect (Fig. 1B).

Leaves that matured after the initial predisposing environmental period were free of weather fleck. At times, however, when environmental factors again favored an outbreak of fleck, new spots would be formed. Thus in successive periods new weather fleck lesions appeared on healthy tissue of previously affected leaves (Fig. 1A), as well as on recently matured leaves higher on the stalk. Weather fleck lesions, as they occurred on different tobacco varieties and on leaves of the same plant, varied from brown through white. Observations suggested that color differences were influenced by stages in lesion development and varietal differences. Brown flecks on normally green tobacco appeared to be associated with incompletely developed lesions, whereas white flecks denoted an area of complete cell disruption retained by the cuticular layers. Weather fleck lesions on burley, however, were usually tan -to- brown in color even in late stages of development (Fig. 1B). Severely affected leaves on burley varieties often

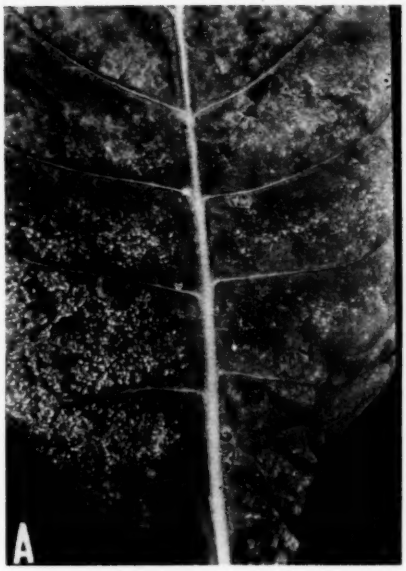

FIGURE 1 A. Typical weather fleck symptoms on leaf of tobacco.

FIGURE 1 B. Right half-leaf, weather fleck on burley; lesions are about same size but are generally darker than on leaves of non-burley types as shown by left half-leaf.

collapsed in 1 to 2 weeks following first appearance of symptoms.

The role of pathogenic organisms was considered in the course of this study; however, repeated failure to isolate specific pathogens from new lesions or to detect pathogenic material in microscopic preparations suggested that this leaf spot resulted from physiologic factors.

Histology

A series of slides prepared by the paraffin method and stained with safranine and fast-green provided information on early stages in the ontogeny of weather fleck lesions. The earliest detectable evidence of breakdown is expressed by abnormal plastids within palisade parenchyma cells. The somewhat shrunken plastids stain intensely with safranine, whereas normal plastids in adjacent cells stain only with fast-green. As breakdown continues plastids in adjacent palisade cells become affected. At the next stage of cell breakdown the protoplast will contract centrally, permitting collapse of the cell wall. The collapse of several palisade cells is reflected in a reciprocal collapse of cells in the upper epidermis. Following collapse of the upper epidermis, cells of the spongy parenchyma and later the cells of the lower epidermis will break down. It is possible that the macroscopically detected brown flecks occur concomitantly with breakdown of the spongy parenchyma. At later stages, when the lesion consists of disrupted cell walls retained by the cuticular layers, the lesion appears white. Under the influence of rain and other environmental forces the cuticular layers may rupture, producing characteristic "shot hole".

Experimental Results

Differences in degree of weather fleck damage were exceptionally clear in an intervarietal test consisting of four varieties and their reciprocal hybrids. The experimental trial consisted of 16 entries: 2 burley varieties, Burley 11A and Burley 2; a flue-cured variety, Virginia Gold;

Table 1. Weather fleck leaf spot on 4 tobacco varieties and their F_1 hybrids.

	Entry No.	Variety and hybrids	Leaf-spot ratings [a]	Leaf spot ratings: Avg. for reciprocal crosses	Leaf spot ratings: Avg. for parental lines	Rank [b]
	(5)	Burley 11A	7.8			1
	(1)	Burley 2	4.0			6
	(9)	Virginia Gold	1.5			11
	(13)	Maryland Medium	0.2			16
Group A	(6)	Burley 11A x Burley 2	6.4	5.3	5.9	2
	(2)	Burley 2 x Burley 11A	4.2			5
Group B	(7)	Burley 11A x Virginia Gold	4.8	4.8	4.7	3
	(11)	Virginia Gold x Burley 11A	4.8			3
Group C	(8)	Burley 11A x Maryland Med.	2.1	2.2	4.0	10
	(15)	Maryland Med. x Burley 11A	2.2			8
Group D	(3)	Burley 2 x Virginia Gold	2.2	2.4	2.8	8
	(10)	Virginia Gold x Burley 2	2.5			7
Group E	(4)	Burley 2 x Maryland Med.	1.3	1.1	2.1	12
	(14)	Maryland Med. x Burley 2	0.8			13
Group F	(12)	Virginia Gold x Md. Med.	0.5	0.5	.9	14
	(16)	Maryland Med. x Va. Gold	0.5			14

[a] Ratings 0 (no leaf spot) to 10 severe leaf spot. Average for 5 replications.

[b] Rank 1 to 16 in order of increasing resistance.

Maryland Medium Broadleaf; and 12 F_1 reciprocal hybrids between all possible combinations of the 4 parental varieties. The experimental design was a randomized block with 5 replications and a 5-plant plot for each entry. On July 20, about 10 days after first appearance of weather fleck, disease expression was indexed from 0 to 10, where 0 indicated no weather fleck and 10 represented the most severe expression. A single reading was recorded for each plot. The parental varieties possessed low, intermediate, and high forms of resistance (Table 1). The dominant effect of the genome from the Maryland Medium parent was clearly indicated in all hybrid combinations in which it was involved. It is worthy of mention that reciprocality did not influence the weather fleck response of any hybrid. The reciprocal hybrid groups, designated as C, E, and F, had leaf-spot ratings that show approximately a 100 percent gain in resistance when compared with the hypothetical averages of the parental lines (Table 1). For example, Burley 11A had an actual leaf-spot rating of 7.8 and Maryland Medium Broadleaf an actual leaf-spot rating of 0.2. The hypothetical parental average was 4.2, whereas the average for reciprocal crosses was 2.2. Hybrids that did not have Maryland Medium Broadleaf as one parent possessed a leaf-spot rating value that merely approximated an artificial value obtained by averaging the leaf-spot ratings of their parents.

Observations made on other tobacco lines and varieties, not included in replicated tests, indicated that dark fire-cured types showed less injury from weather fleck than burley varieties. Susceptibility varied among lines and varieties as well as within types as shown by the leaf-spot ratings of Burley 11A and Burley 2 (Table 1). The F_1 and segregating generations will have to be studied before any conclusions can be made regarding the inheritance of weather fleck resistance from Maryland Medium Broadleaf and other resistant varieties.

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FIELD CROPS RESEARCH BRANCH, AGRICULTURAL RESEARCH SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL TREATMENTS WITH PCNB (TERRACLOR) FOR CONTROL OF POTATO SCAB

T. J. Nugent

Experimental work elsewhere (2, 3) has demonstrated that soil treatments with PCNB (pentachloronitrobenzene), now called Terraclor, would give considerable control of Irish potato scab, caused by Streptomyces scabies. To evaluate this material under conditions in eastern Virginia, field trials were made during 1955 at the Virginia Truck Experiment Substation, Onley, Virginia on land that had been heavily infested with the scab organism for several years.

The land was prepared as for planting; rows 3 feet apart were furrowed out; and the PCNB (20% active dust) was applied with a modified hand-operated fertilizer spreader to the open furrows. The material was then worked into the soil. The same day (March 10) cut seed of the Cobbler variety were hand-planted 14 inches apart, and fertilized and covered with a one-row potato planter. It was calculated that 58, 116, and 174 pounds of the active material were applied per acre. Four replicates (40 seed piece replicates) were randomized for each treatment rate and the untreated check plots.

The data obtained in this test are listed in Table 1. Stand counts made on April 26 showed no significant differences between treatments. At harvest (June 30) the US #1 size potatoes from each replicate were graded for scab severity and a scab index was determined. When these data were analyzed, no significant differences were found between the three rates of PCNB but all had significantly less scab than the untreated plots. The number of potatoes produced per plot was not significantly different for the various treatments. Weight yields, however, for both total and marketable potatoes of US #1 size showed significant increases for the three rates of PCNB compared to check. Thus, yield increases were primarily due to an increase in size of the potatoes produced. The fact that the higher rates of application of PCNB

Table 1. The effect of PCNB on emergence, severity of scab and yields of Cobbler potato.

Pounds active material/A	Emergence counts	Scab index[a]	Yields: Number tubers per plot	Yields: 100# bags/A of US #1 Size: Total	Yields: 100# bags/A of US #1 Size: Marketable
58	98.7	29.3**	224	140*	66*
116	97.5	29.7**	209	136*	76*
174	96.3	36.0*	204	133*	60*
None (check)	98.7	50.7	211	113	31
LSD at 5% level	NS	10.8	NS	16.8	25.5

[a] Scab index of 0 for no scab to 100 when all potatoes severely scabbed.
* and ** Denotes significant differences from check at 5 and 1 percent respectively.

failed to further reduce the incidence of scab would indicate lack of thorough mixing of the materials into the soil. However, Fink (1) thoroughly mixed the material by disking and reported somewhat similar results in regard to scab severity for the various treatment rates of this material.

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VIRGINIA TRUCK EXPERIMENT STATION

VARIATION IN VERTICILLIUM ALBO-ATRUM FROM POTATO

Paul E. Waggoner

SUMMARY

Large differences in pathogenicity to Kennebec and Saranac potatoes existed within as well as between microsclerotial and non-microsclerotial types of Verticillium albo-atrum and within as well as between mass isolates of that fungus. The relative pathogenicity of 4 single-spore isolates varied during 1 year. No distinct evidence was seen of specificity of isolates for Kennebec, Saranac, or the more resistant Houma varieties.

Verticillium wilt of potatoes has caused considerable early dying and reduction of yields in the northern potato growing regions. Attempts have been made to control this soil- and seed-borne pathogen by means of rotation, seed and soil treatment, chemotherapy, and resistant varieties. None of these methods has proven wholly successful.

The use of resistant varieties is attractive because of its low cost. However, the practicality of this method depends upon the speed with which changes in pathogenicity of Verticillium take place. The frequency of variation in morphology of the fungus (5) and the differences between regions in varieties resistant to it (4) suggest that pathogenicity of Verticillium does vary.

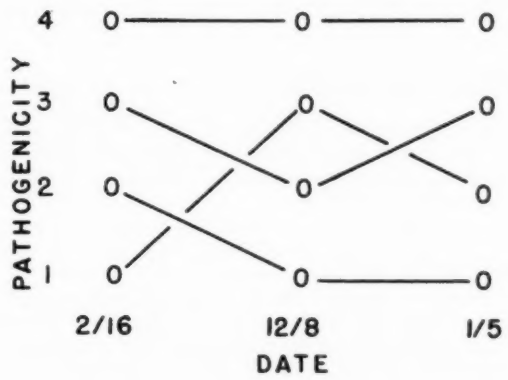

FIGURE 1. Change in rank in pathogenicity of 4 single-spore isolates in 3 experiments in 12 months.

Three aspects of variation were examined: How much difference in pathogenicity exists within the two microsclerotial types, sometimes referred to as the two species Verticillium albo-atrum and V. dahliae, and how much within mass isolates of the fungus? Are differences in pathogenicity persistent? Do several varieties all react in the same way to differences in pathogenicity?

MATERIALS AND METHODS

Two mass isolates, 20 and 30, of Verticillium albo-atrum from Maine potatoes were furnished by Dr. D. Folsom. These isolates produce dark, olivaceous mycelium but have not produced any microsclerotia in their 2-year history. Two mass isolates, 10 and 109, of the pathogen from Connecticut potatoes consistently produce microsclerotia. These isolates have been examined cytologically by Khoo et al. (3). More than 99 percent were uninucleate. Single spore isolates were made from three of the mass isolates as indicated by a letter added to the mass isolate number. These have retained the morphological characteristics of their parent

Table 1. Mean number of leaves yellowed or dead 39-41 days after inoculation. Plants in 4 replicates had 12-13 leaves.

Variety	Isolate						
	20I	20D	30A	30L	109A	109B	10
Dec. 8, 1955							
Kennebec	6.8		3.2	1.2	4.2		1.8
Saranac	7.2		3.0	2.0	2.0		2.5
Houma	1.0		1.2	1.2	1.2		1.5
Jan. 5, 1956							
Kennebec	11.8	11.5	10.8	1.0	3.2	3.0	2.5
Saranac	11.2	10.8	6.8	0.8	2.2	3.2	3.2
Houma	2.0	2.8	1.5	0.8	1.2	1.5	0.8

mass isolates for 16 months. The isolates were cultured on nutrient broth containing 3 percent glucose.

Saranac and Houma seed furnished by Dr. R. V. Akeley and Kennebec seed were grown in the greenhouse at 65° F in steamed, composted soil. They were uprooted, the roots were dipped in cultures of the pathogens, and the plants were repotted. After 19 days the severity of symptoms was ranked in each of 6 replicates, or in later experiments the number of dead or yellowed leaves in 4 replicates was counted after 39 to 41 days. In these later experiments the plants had about 12 leaves on a single stem. Uninoculated plants had one to two yellowed or dead leaves at the end of 41 days.

RESULTS AND DISCUSSION

Isolates within the two microsclerotial types varied in pathogenicity as much as the two types varied (Table 1). This is shown by the large range in severity of symptoms produced by non-microsclerotial isolates 20 and 30 on Kennebec potatoes. The range extends both above and below that of the microsclerotial isolates 10 and 109.

Single-spore isolates from the same mass isolate varied in pathogenicity. For example, isolate A from 30 is highly pathogenic to Kennebec potatoes (Table 1) while another single-spore isolate, L, from the same mass isolate, 30, is not pathogenic at all.

The pathogenicity of single-spore isolates varied. Four of the isolates shown in Table 1 were used to inoculate 6 replicates of Kennebec potatoes in February, 1955. The severity of symptoms was ranked (Figure 1). When the results of the experiments in December 1955 and January 1956 (Table 1) are added to Figure 1, we see that the relative pathogenicity of the 4 isolates varied somewhat during 1 year.

The isolates so far examined showed no marked host specificity. Thus, the behavior of an isolate can be fairly well described in terms of, 1) its action on all of the varieties, and 2) the average susceptibility of the variety concerned (Table 1). Therefore, we have found pathic but not hostic races (7).

The isolates of Verticillium from Maine and Connecticut potatoes that we have seen have been distinctly of one morphological type or another: with few exceptions they have produced either no microsclerotia or an abundance of microsclerotia throughout their observed history. However, morphology has not been correlated with pathogenicity. The virulence of an isolate of Verticillium, therefore, cannot be foretold from observation of its morphology, although in the experience of both Isaac (2) and ourselves the most pathogenic isolates did not produce microsclerotia.

We found no evidence of specificity of isolates for varieties. However, we did find evidence of variation in virulence. First, within the large population of a mass isolate, great differences were found. Second, time-changes occurred in single-spore cultures that were probably genetically homogenous originally. Some of the difference in varietal resistance from one region to another, therefore, is probably due to races of the pathogen (4). This indicates further that strains of Verticillium exist or will arise to attack resistant varieties. It does not mean, how-

ever, that resistant varieties could not provide useful control for a number of years in some regions.

The results in Table 1 show that Saranac is susceptible and Houma resistant to some Verticillium strains in the Northeast. This is only partially borne out by experience in the field. Saranac was resistant in some fields, susceptible in others, in Connecticut in 1955 (6). Houma, which has been resistant in Maine (1), was not resistant in Connecticut in 1955 (6). As McLean has suggested (4) environment as well as races of the pathogen must modify resistance in the host.

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THE FOLIAGE SUSCEPTIBILITY OF SOME SPECIES OF CUCURBITACEAE TO TOMATO ANTHRACNOSE-INCITING FUNGI[1]

Maria E. Pantidou and W. T. Schroeder

ABSTRACT

Foliage inoculation tests in the greenhouse indicated that varieties of Cucumis sativus L., Cucumis melo L., Cucurbita pepo L. and Cucurbita maxima Duchesne were susceptible to eight isolates of tomato anthracnose-inciting fungi. Symptoms varied, according to variety and the fungus isolate, from tiny whitish-brown specks to large necrotic areas, all capable of producing spores that were infective on healthy, uninjured tomato fruits.

INTRODUCTION

Tomato anthracnose is generally attributed to Colletotrichum phomoides (Sacc.) Chester. Some doubt is expressed in the literature as to its being the sole causal organism, because organisms such as Glomerella cingulata (Stonem.) Spauld. & Schrenk and isolates of Colletotrichum from hosts other than tomato have produced typical anthracnose on that crop (1, 2, 3, 5, 6, 7).

The causal fungus of tomato anthracnose is generally assumed to overwinter as infected tomato debris in the soil, thereby supplying the source of inoculum for the succeeding tomato crop. Rotation, often advised as a control measure on the assumption that the organism will diminish or die out after the infected debris is completely decomposed, has not been very successful. Some of the worst outbreaks of tomato anthracnose in western New York have occurred in fields where tomatoes had not been grown for five or more years. In many of these fields, tomatoes were the first crop following the removal of an old apple orchard. In other instances, old neglected apple orchards bordered the fields. One striking development of anthracnose occurred in a tomato field that had been cropped to muskmelons the previous year. Colletotrichum isolates obtained from lesions on squash fruits have proved as pathogenic on tomato as have tomato isolates, but a culture of C. lagenarium (Pass.) Ell. & Halst. was not pathogenic. The beta strain of C. lindemuthianum (Sacc. & Magn.) Briosi & Cav. was pathogenic on tomato, whereas the alpha and gamma strains were not. Other species of Colletotrichum have been proved pathogenic on tomato, although the symptoms were somewhat atypical and the incubation periods were usually longer than those of the typical tomato disease.

No attempt is hereby made to disprove the specificity of Colletotrichum species, but in view of the above observations it was deemed advisable to study, in part at least, the host range of some of the tomato anthracnose isolates, primarily to find out if they could establish themselves on other crops. If so, such crops could serve to carry the fungus over to a tomato crop the succeeding year. The test hosts reported herein include only the various species of Cucurbitaceae commercially grown in New York State.

MATERIALS AND METHODS

Two inoculation experiments, one in August through September of 1952, the other in June through July of 1953, were conducted in the greenhouse with four species of the family Cucurbitaceae. They included cucumber (Cumis sativus L.), var. Straight 8; muskmelon (Cucumis melo L.), vars. Emerald Gem and Delicious; pumpkin and fall squash (Cucurbita pepo L.), vars. Sugar Pie and Table Queen, respectively; and squash (Cucurbita maxima Duchesne), vars. Golden Delicious, Blue Hubbard, and Boston Marrow.

The isolates used in the inoculation tests were obtained either from tomato or some other host. Each isolate was single-spore, and its pathogenicity on tomato was proved on the uninjured fruit. The various isolates, designated by numbers, are described as to source, type of growth on potato dextrose agar, and spore dimensions in Table 1. Each of the isolates was used to inoculate three plants in each of three plots by atomizing the plants at the 2 to 3 true leaf stage with the spore suspension. After inoculation, the plants were held in a misted green-

[1] Approved by the Director for publication as Journal Paper No. 1034, New York State Agricultural Experiment Station, Geneva, New York, March 12, 1956.

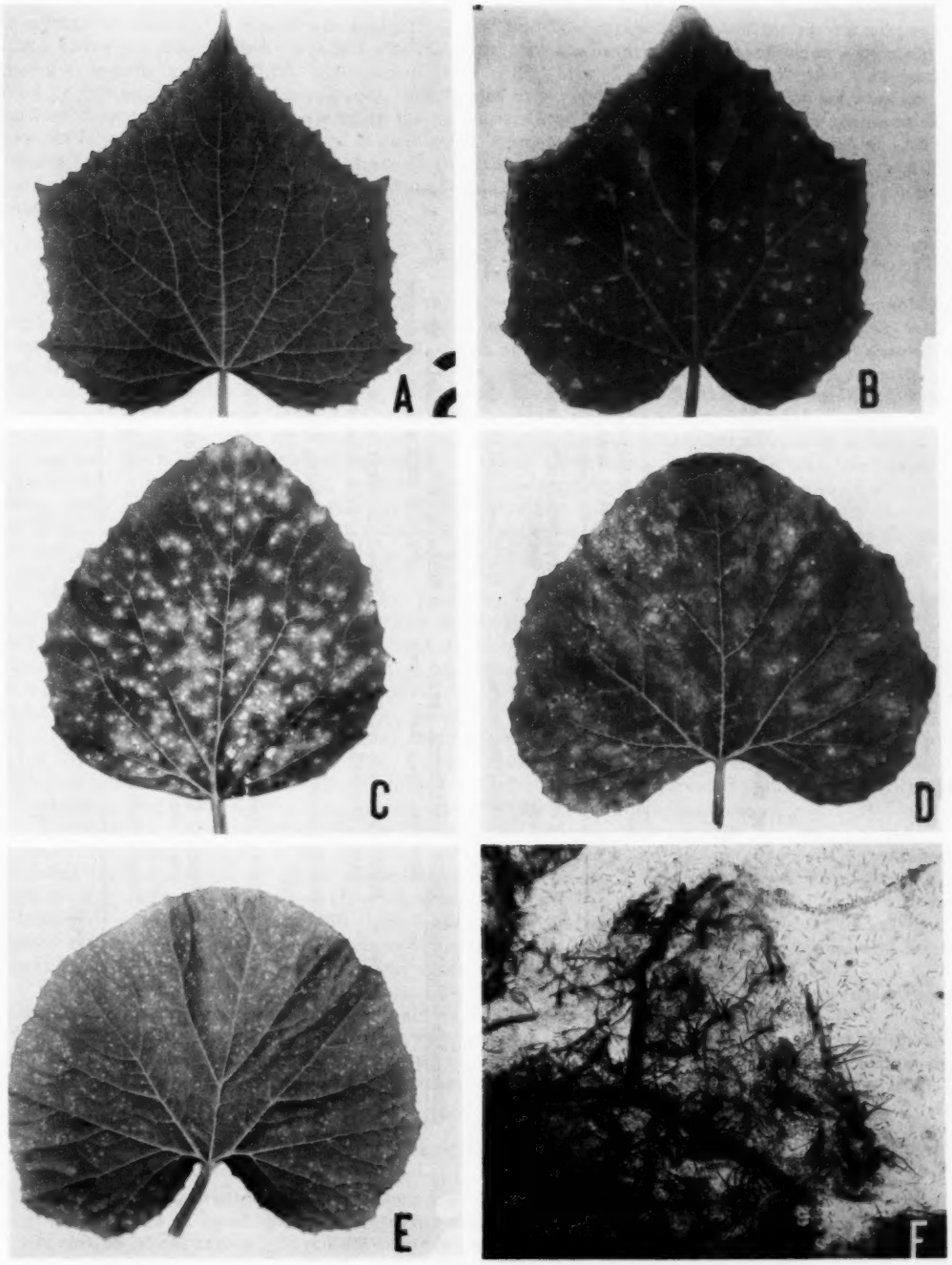

FIGURE 1. Lesion development and sporulation on leaves of cucurbit varieties inoculated with spores from isolates of tomato anthracnose inciting fungi: (A) Non-inoculated Straight 8 cucumber; (B) Straight 8 cucumber isolate 4; (C) Delicious melon, isolate 4; (D) Table Queen squash, isolate 4; (E) Sugar Pie pumpkin, isolate 70; (F) Setae and spores from a foliage lesion in D.

Table 1. Sources and description of the isolates of Colletotrichum and Glomerella used in these investigations.

Isolate no.	Organism	Source	Type of 10-day-old growth on potato dextrose agar	Spore size[a] in μ
4	C. phomoides	Tomato fruit, Fredonia, New York	Mycelium fluffy, solid gray-brown	10-22 X 3
8	C. phomoides	Tomato fruit, Rochester, New York	Black sclerotial type	12-22 X 3
32	Glomerella cingulata	Apple, California Spray-Chemical Co., New Jersey	White mycelium encircled by profuse pink masses of spores	5-15 X 3
42	Colletotrichum sp.	Internal tissue of tomato stem, Fredonia, New York	Mycelium purplish to orange: sclerotia submerged	15-22 X 3
44	Colletotrichum sp.	Squash, Geneva, New York	Mycelium dark, thick; black sclerotia	16-18 X 3
47	Colletotrichum sp.	Squash, Geneva, New York	Mycelium dark, thick; black sclerotia	18-22 X 3
50	Colletotrichum sp.	Internal tissue of tomato stem, Geneva, New York	Mycelium dark with smooth surface	18-22 X 3
70	Colletotrichum sp.	Tomato fruit skin, Germany	Mycelium light gray	14-18 X 3.5

[a] Based on at least 100 spores.

house for 48 hours at a temperature of 27° to 30° C. The concentration of the spore suspensions of the various isolates was not standardized, but the minimum concentration was maintained at approximately 60,000 spores per cubic milliliter. The degree of infection was measured by the number of lesions per leaf, and it was observed to be independent of the concentration of spores. Within a week after the appearance of lesions, the plants were exposed to mist or high humidity for 48 hours to encourage sporulation. Microscopic examination of the lesions for sporulation was accomplished by cutting out 1 centimeter-square pieces of leaf tissue, clearing in several changes of pyridine and mounting them in lactophenol, as described by Leben (4).

RESULTS

The foliage susceptibility of cucurbit varieties to infection by tomato anthracnose-inciting fungi varied in degree according to the isolates used in the tests. Isolates 4 and 8, originally from diseased tomato fruit, and isolate 47, from squash fruit, produced the greatest number of lesions on all of the varieties. Isolate 44, from squash fruit, and isolate 70, from tomato fruit, also infected all of the cucurbits tested, but the degree of infectivity was somewhat less on some varieties, notably isolate 70 on Boston Marrow and Table Queen squash. Isolate 32, Glomerella cingulata, was the least infective, although the concentration of spores in the inoculum was the highest among the isolates. It produced no lesions, in either test, on Sugar Pie pumpkin. Isolates 42 and 50, both originally isolated from the vascular tissue of tomato roots, were only slightly more infective than isolate 32. On some varieties, they produced no infection. For instance, isolate 42 produced no lesions on Emerald Gem melon nor on Sugar Pie pumpkin, and isolate 50 appeared to be noninfective on Straight 8 cucumber and Delicious melon.

The severity of symptom expression appeared to be a function of both the host and the isolate. Some isolates, notably number 70 on Sugar Pie pumpkin, produced numerous tiny whitish-brown specks (Fig. 1E). That type of lesion, however, was not restricted to this isolate nor to Sugar Pie pumpkin. Straight 8 cucumber characteristically developed a distinct brown, somewhat angular lesion, surrounded by a narrow chlorotic band (Fig. 1B). In some instances, symptoms were expressed as large necrotic areas, transparent, rather irregular, and surrounded by wide chlorotic halos, as from infections by isolate 4 on Delicious melon and Table Queen squash (Figs. 1C and 1D). Large lesions on petiole and stem also occurred on such plants and the leaves soon died. In general, Delicious and Emerald Gem melons, Straight 8 cucumber, and Table Queen squash developed the most severe symptoms.

Microscopic examination of the leaf lesions, following a 48-hour high humidity period, revealed sporulation on all of the cucurbit varieties that exhibited lesions. Isolate 4 produced abundant acervuli in the leaves of Table Queen squash, Sugar Pie pumpkin, and Straight 8 cucumber (Fig. 1F). Spores were also found in stem lesions. Isolate 8 developed many acervuli in leaves of Sugar Pie pumpkin, Straight 8 cucumber, Delicious melon, Golden Delicious and Boston Marrow squashes, as did isolate 44 on Straight 8 cucumber, Delicious melon and Table Queen squash. Isolate 47 also developed setae and spores on Emerald Gem melon.

The pathogenicity on tomato of the isolates sporulating on cucurbit leaves was confirmed by atomizing the spore suspensions on healthy, uninjured tomato fruits.

Similar studies have been conducted with isolates of tomato anthracnose-inciting fungi on bean and onion. Bean does not appear to be susceptible as do the cucurbits, but there is some indication that onion may serve as host for some of the isolates. These tests have not been repeated for confirmation.

DISCUSSION

The evidence presented clearly shows that certain isolates of tomato anthracnose-inciting fungi are capable of establishing themselves and sporulating on the foliage of certain species and varieties of cucurbits. Some differences in degree of varietal susceptibility may exist among isolates of the fungi, and infection in the field might not be as apparent nor as abundant in the field as in the greenhouse tests. Nevertheless, it appears that members of the Cucurbitaceae could serve as overwintering reservoirs of the pathogen and account for the severe outbreaks of the disease in tomato fields cropped to cucurbits the preceding season. The possible susceptibility of other crops, such as onion, indicates that a rotation to avoid a high incidence of tomato anthracnose should consider suscepts other than just tomato.

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TWO FOREIGN CUCUMBERS RESISTANT TO BACTERIAL WILT AND POWDERY MILDEW

J. D. Wilson[1], C. A. John[2], H. E. Wohler[3] and M. M. Hoover[4]

The Section of Plant Introduction at Ames, Iowa, the Ohio Experiment Station at Wooster, Ohio, and the Crop Research Department, H. J. Heinz Company, Bowling Green, Ohio, have conducted cooperative screening tests to determine the resistance to bacterial wilt (Erwinia tracheiphila) of cucumber lines collected from various countries. The studies were started in 1952. From 30 to 152 selections have been studied each year. Any line that exhibited appreciable resistance was retested the following year. Depending upon germination and survival, 12 to 30 plants each of over 300 individual lines were studied. Among all lines studied only P. I. Nos. 200815, 200818, and 222187, (Table 1) showed definite resistance.

Inoculum was prepared by grinding bacterial wilt-infected plants in an ordinary food grinder, twice filtering the extracted juice with suction through a cotton filter and adding an equivalent amount of distilled water. When the third and fourth true leaves were fully developed, two holes, the lower about 1 1/2 inches and the other about 2 1/2 inches above ground, were punctured in the stem with a No. 20 hypodermic needle. The inoculum was forced into the upper hole until it exuded from the lower. Survivors from the first inoculation were reinoculated 1 week later, and the survivors of the second inoculation were given a third treatment 2 weeks later. On rare occasions, a plant might be injured or broken by this treatment but mortality from this cause was extremely low.

P. I. 200815 and 200818 are very similar in appearance and fruit type but 200815 has been much earlier in maturity especially under greenhouse conditions. Both of these lines were collected in Burma and were cultivated in that country in 1950. The plants of both introductions are somewhat similar to most cultivated cucumbers in America but the fruits are spineless, being covered with coarse hairs. Resistant plants of both lines showed some symptoms of wilt 24 hours after the third inoculation and these symptoms were noticeable for 2 or 3 days thereafter. However, 1 week after the third inoculation, the resistant plants appeared very vigorous and continued to grow until frost. It is not known whether the non-resistant plants (Table 1) represent mixtures, outcrosses, or possible incomplete resistance of uncertain genic composition.

Both lines showed marked symptoms of virus infection, which was not identified specifically but was presumed to be due to cucumber mosaic virus. The mosaic symptoms were confined principally to the foliage, as the plants continued to form male and female blossoms until late in the season.

Table 1. Bacterial wilt inoculation studies completed on certain cucumber accessions, Bowling Green, Ohio, 1955.

Line		1954		1955	
		No. of plants inoculated	No. of plants resistant	No. of plants inoculated	No. of plants resistant
P. I.[a]	200815	23	17	24	21
P. I.	200818	14	11	18	17
P. I.	222187	--	--	16	16

[a] Plant Introduction, United States Department of Agriculture.

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During the early part of September powdery mildew (Erysiphe cichoracearum) became epiphytotic and was purposely left uncontrolled in this plot. Both of these lines remained remarkably free from this disease while other lines in the plot became severely infected.

PLANT INTRODUCTION STATION, AMES, IOWA; OHIO AGRICULTURAL EXPERIMENT STATION, WOOSTER; AND CROP RESEARCH DEPARTMENT, H. J. HEINZ COMPANY, BOWLING GREEN, OHIO

GUMMY STEM BLIGHT AND OTHER DISEASES ON CUCURBITS IN SOUTH CAROLINA IN THE 1955 FALL SEASON

William M. Epps

Experimental plantings of muskmelons, cucumbers, and watermelons on the Clemson College Truck Experiment Station farm at Charleston, South Carolina, were damaged severely by gummy stem blight (Mycosphaerella melonis) in the 1955 fall season. Other foliage diseases were more prevalent than usual, particularly on the muskmelons.

It is probable that this unusual outbreak of gummy stem blight was brought about by two factors: 1) intensive culture of cucurbits in the Station research program for many years and 2) the excessive and frequent rains of early September when over 12 inches fell between August 31 and September 16. This disease has appeared frequently in past seasons so that the pathogen has undoubtedly built up in the soil, but the damage caused has rarely been significant. The excessive rains during the first half of September produced conditions ideal for the spread of the disease and also prevented proper adherence to the normal 5-day fungicide schedule.

The fungus attacked the stems, petioles, leaf blades, and fruits of muskmelons, causing serious defoliation of all four varieties planted and almost complete defoliation of the two more susceptible varieties. Most of the defoliation resulted from destruction of the petioles rather than from direct destruction of the leaf blades. The lesions on the petioles were at first watersoaked, later turning light brown and finally dark brown or almost black. They varied from 1 to 2 or more inches in length and almost always completely girdled the petiole. The leaf blade remained green for several days after the lesion appeared but eventually withered and died as the petiole darkened. The stem lesions were similar to those on the petioles and usually resulted in the death of that portion of the stem beyond the lesion. The leaf lesions were irregularly rounded in shape and often an inch or more in diameter. Numerous perithecia and a few pycnidia appeared on the stem and petiole lesions, while only pycnidia were observed on the leaf blade lesions.

Fruit lesions occurred both on ripe and unripe fruits. The firm sunken lesions, covered with the fruiting structures of the fungus and considered typical of the "black rot" phase of this disease, occurred mostly on ripe and overripe melons. Many of the lesions on unripe melons were not readily apparent from the external appearance of the fruit. Often the only observed abnormality was a slight roughening of the net at the point of penetration. In more severe cases the lesions were dark, sunken and marked with deep cracks. The decayed area within the flesh was almost always much greater than the area of the surface lesion. The decayed tissue was clearly delimited, chocolate brown in color, and rather dry and firm in texture. As the melon ripened the rind over the decayed area tended to remain green instead of turning yellow. This resulted in a green halo around the lesion or a green spot on yellow melons where the lesion was not readily apparent externally.

The four varieties included in this test varied greatly in their degree of susceptibility. Homegarden (Mississippi 4852) was almost completely defoliated and a fair percentage of the fruits were attacked. The foliage of Rio Gold was slightly less susceptible. Its fruits, however, were attacked even more severely than were those of the Homegarden variety. Georgia 47 and Smith's Perfect showed some degree of foliage resistance and very few of the fruits were attacked. Both varieties were damaged rather seriously, but had adequate foliage to mature a crop of edible melons after the September rains were over. It is possible that the observed differences in susceptibility were somewhat magnified due to the stage of development of the varieties at the time of the attack. The Homegarden was the earliest of the four, followed in order by Rio Gold, Georgia 47, and Smith's Perfect.

Alternaria leaf spot (Alternaria cucumerina) completed the destruction of Rio Gold, Georgia 47 and Smith's Perfect appeared to have considerable resistance to this disease. Powdery mildew (Erysiphe cichoracearum) defoliated the Smith's Perfect soon after harvest began. Rio Gold and Georgia 47 appeared highly resistant to powdery mildew. Georgia 47 was thus the only one of the four varieties that produced even a fair crop, and its fruits were thin fleshed and of only moderate quality because of the partial defoliation by gummy stem blight. Downy mildew (Pseudoperonospora cubensis) was present throughout the season but caused no appreciable damage because all the varieties included in the test were resistant. Anthracnose (Colletotrichum lagenarium) was also present but was not sufficiently prevalent to permit valid observations on the relative susceptibility of the various varieties. The relative susceptibility of the varieties to these diseases is summarized in Table 1.

Table 1. The relative susceptibility[a] of four muskmelon varieties to the foliage and fruit diseases prevalent in the 1955 fall season, South Carolina.

Variety	Downy mildew	Gummy stem	Alternaria leaf spot	Powdery mildew
Homegarden	2	4	-	-
Rio Gold	1	3	4	1
Georgia 47	1	2	2	1
Smith's Perfect	1	2	2	4

[a] The system used in measuring relative susceptibility was as follows:
1 -- Highly resistant; 2-- Moderately resistant; 3 -- Moderately susceptible;
4--Highly susceptible.

Gummy stem blight was also more severe than usual on cucumbers and watermelons. A small planting of Sugar Baby watermelon was completely defoliated. On this host the damage was primarily to the leaf blades and stems. Petiole lesions were infrequent and no fruit lesions were observed. The damage on cucumbers was serious only in spots in the fields and was due mainly to leaf blade lesions, although some fruit, petiole, and stem lesions developed. The apparently superficial lesions on the stem near the soil line, which are often seen on fall cucumbers, were present on a high percentage of the plants. Fruit rot caused serious losses only on fruits that were allowed to remain on the plants until the seeds reached maturity. Cucumber varieties varied somewhat in their degree of resistance, but none appeared to be highly susceptible or completely resistant.

CLEMSON COLLEGE TRUCK EXPERIMENT STATION, CHARLESTON, SOUTH CAROLINA

AN EVALUATION OF FUNGICIDES FOR THE CONTROL OF DISEASES OF CUCUMBERS IN SOUTH CAROLINA, 1946-1955

William M. Epps

Prior to 1948 very few cucumbers were grown during the fall season in South Carolina. Downy mildew (Pseudoperonospora cubensis) was regularly so severe that yields were poor and returns were low in spite of the normally high prices for cucumbers at that time of the year. The mildew-resistant variety, Palmetto, released in 1948, made possible the effective control of this disease by the use of fungicides, even after the appearance in 1950 of a new race of the pathogen which was capable of causing considerable injury to the resistant Palmetto variety. In addition to downy mildew, anthracnose (Colletotrichum lagenarium) and fruit rot (Pythium aphanidermatum) have often caused serious losses in the fall crop. These two diseases assumed even greater importance after the use of Palmetto reduced the importance of downy mildew.

Tests were initiated in 1946 to develop a fungicide program applicable for use on the downy-mildew-resistant varieties. The rapid development of new fungicides during this period necessitated the continuation of this study even after a satisfactory program had been developed.

Under natural conditions downy mildew spread uniformly over the plots and, in most seasons, became sufficiently severe, even on the Palmetto variety, to result in definite injury to the untreated rows. Fruit rot developed primarily during rainy weather and was most serious in the low wet spots in the field. Its distribution was sufficiently uniform, however, that control data gave good comparisons of the relative effectiveness of the various fungicides. Anthracnose, under natural conditions, occurred in spots and spread so irregularly that it was necessary to inoculate plots artificially in order to obtain uniform distribution of the disease over the plot area.

Information on the control of anthracnose and fruit rot was obtained primarily by counting the number of diseased fruits at harvest. In a few tests, in which anthracnose was the dominant disease, the degree of control could be measured by estimating the amount of defoliation in the various plots. The relative effectiveness of various fungicides against downy mildew was measured by the degree of defoliation and by the effect on yield.

The volume of data obtained from the 18 individual tests prevents their publication herein. Most of these data have been published elsewhere[1].

None of the 25 fungicides tested gave adequate control of all three diseases, downy mildew, anthracnose, and fruit rot. Maneb (Manzate and Dithane M-22) gave effective control of both anthracnose and downy mildew and better control of fruit rot than did any other fungicide tested, thus most nearly approaching the ideal control. The reduction in the number of rotted fruits, which amounted to about 50 percent, was statistically highly significant in several tests but is not considered adequate. Most of the tests were conducted with Manzate. Dithane M-22, which appeared on the market in 1954, appeared equal to Manzate in two tests against anthracnose and Pythium fruit rot and only slightly inferior to Manzate in one test against downy mildew.

Zineb (Dithane Z-78 and Parzate) ranked second to maneb in general effectiveness. It was somewhat less effective than maneb against each of the three diseases. Parzate performed very poorly in tests conducted prior to 1950. The product was changed by 1950, however, so that it approached, although never quite attained, the effectiveness of Dithane Z-78 against downy mildew. The two products were apparently equal against anthracnose. Ziram (Zerlate) was recommended and used commercially for one season (1948) because of its effectiveness against anthracnose and downy mildew and its lower phytotoxicity as compared to the fixed coppers. It was quickly replaced, however, by the more effective Dithane Z-78 after the latter became available in 1949.

Several fungicides gave good control of either downy mildew or anthracnose but failed to control both diseases. The fixed copper fungicide, Tribasic Copper Sulfate, and the two organic fungicides, Phygon XL (dichlone) and Ethyl B622 (2,4-dichloro-6-(o-chloroanilino)-s-triazine), were effective against downy mildew and relatively ineffective against anthracnose. Ethyl B622 was the only fungicide, in addition to maneb, which was tested against fruit rot in more than one season and gave a consistent reduction in the severity of the disease. Four organic fungicides, Orthocide 406 (captan), Fermate (ferbam), Calspray 525, and Vancide F995W, gave good control of anthracnose but were only moderately effective against downy

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mildew. Captan was probably the most effective of all the fungicides tested against anthracnose, although it was compared directly with maneb under conditions of severe anthracnose only in 1954.

In addition to the materials mentioned above, 13 other fungicides were tested. The copper fungicides, Copper Compound A, Cop-O-Zinc, Copper Zinc Chromate, Yellow Cuprocide, Robertson Copper, and Copper No. 30, were discarded either because of phytoxicity or inability to control anthracnose. Six organic fungicides, Carbide and Carbon 5379, Pittsburgh 4255, Vancide 51ZW, thiram, and Pennsalt NP492 and 1282, failed to control either downy mildew or anthracnose effectively. Tennam (Tennessee Corp.) gave partial control of anthracnose. It was not tested against downy mildew. Pennsalt 1282 and Tennam gave some reduction in the severity of fruit rot during the one season in which each was tested.

Few of the fungicides tested were phytotoxic to cucumbers. The fixed coppers caused some injury, especially when used at 5-day intervals, the degree of injury varying from season to season. Cuprocide and Copper Compound A appeared slightly more phytotoxic than Tribasic Copper Sulfate. The sample of Phygen used in 1946 caused severe injury, but the Phygon XL used in 1950 appeared completely safe. Pennsalt Fungicide 1282, which was tested only in 1953, caused slight injury.

Maneb and zineb, in that order, are currently recommended for use on cucumbers in South Carolina. Recommendations have been changed four times during the 10-year period covered by these tests. The fixed coppers were being recommended in 1946 when these tests were initiated. Ziram (Zerlate) was recommended only in 1948. It was quickly replaced by Dithane Z-78 (zineb) in 1949 because the Dithane was slightly more effective and because growers found Zerlate objectionable to the duster operator. In 1949 and 1950 only Dithane Z-78 was recommended because of the ineffectiveness of the zineb in Parzate prior to 1950. The recommendation was changed in 1951 so as to include both Dithane Z-78 and Parzate, after a change in the manufacturing process rendered Parzate essentially equal to Dithane Z-78. Reports from the manufacturer of phytotoxicity to other cucurbits caused some delay in the recommendation and use of maneb. Maneb was tested on three varieties of cucumbers, both as a dust and as a spray, each at several concentrations, and over a 5-year period. There was no evidence of phytotoxicity, and it was consistently superior to all other fungicides included in the tests in overall effectiveness against the three diseases which threaten the cucumber crop in the South Carolina Coastal area. It was first recommended for commercial use in 1954 after 3 years' tests and is currently the preferred material for use on cucumbers.

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CONTROL OF GRAY MOLD ON STRAWBERRIES UNDER GREENHOUSE CONDITIONS

E. M. Stoddard and P. M. Miller

SUMMARY

In greenhouse trials thiram and dichlone gave good control of gray mold of strawberries for 18 days after spraying. Thioneb, Mesulfane and Norsulfane at the higher concentrations gave good control for 10 days but not 18 days. Captan gave moderate control for 10 days, but nabam, ziram, and Puratized 1180 were unsatisfactory. The plants in all cases were sprayed but once.

Gray mold, caused by Botrytis cinerea Pers. ex Fr., is always a serious disease of strawberries in years when rainy weather or conditions favoring heavy dews occur between bloom and harvest. In the field the causal fungus does not readily infect the ripe fruit but attacks more particularly the pedicels of the flower buds and the stems and the calyces of the small green fruit. Besides causing severe damage the infection of these parts of the plant builds up a reservoir of inoculum which in rainy weather will infect the ripening crop with a massive spore load impossible to control effectively with sprays during harvest. The experiments here reported were designed to test the effectiveness of the several materials at the stage of plant development when maximum damage occurs in the field and under optimum conditions for development of the causal fungus.

EXPERIMENTAL

The materials tested were Thioneb (polyethylene thiuram sulfide), Mesulfane (N-methane-sulfon-N-trichloromethano-mercapto-4-chloranilide), Norsulfane (N-methano-sulfon-N-trichloromethano-mercapto-anilide), Puratized 1180 (a non-metallic thiocarbamate derivative), ziram, nabam, dichlone, captan, and thiram. In field and greenhouse trials the two latter materials have been reported by Marsh et al. (2, 3, 4) to give significant control of gray mold, and Powell (5, 6) and Horn (1) have reported good results in field trials with captan.

Pot-grown strawberry plants, variety Stelemaster, with buds, flowers and small green fruits, were sprayed once with the several materials. After the spray deposit had dried, the plants were inoculated with a heavy spore suspension obtained from a mass isolate of B. cinerea. The plants were kept in a moist chamber for the duration of the experiment at a night temperature of 65° F. The humidity was maintained sufficiently high by intermittent misting to keep the plants wet at all times during the first 10 days. From the tenth to the eighteenth day following inoculation the plants received only occasional mistings. Two trials were made, using the same variety of plants, spraying and inoculation techniques, and source of inoculum. The data for both trials are given in Table 1.

RESULTS AND DISCUSSION

It will be noted that thiram at 3 and 1 1/2 pounds per 100 gallons and dichlone at 3/4 pounds per 100 gallons gave a high degree of control for 18 days. Thioneb was equally satisfactory at the highest concentration. Mesulfane and Norsulfane gave good control for a 10-day period but were less satisfactory after 18 days. Captan gave moderate to poor control at both periods. Translated into field control, a material giving protection for 18 days of simulated rainy weather would carry the crop through the picking season.

It is fully realized that greenhouse results cannot always be translated into field control. However, the performance of the better materials under the severe conditions of the experiments make it seem probable that field trials would follow the pattern of the results of these trials.

Table 1. Fungicidal control of gray mold on strawberries in greenhouse tests, Connecticut.

Treatment	Pounds per 100 gals.	Total no. berries	Percent control after 10 days	Percent control after 18 days
		Experiment 1[a]		
Thioneb	3	43	77	70
Thiram	3	40	75	68
Mesulfane	3	66	80	52
Norsulfane	3	63	67	51
Puratized 1180	3	53	55	21
Captan	6	64	50	44
Ziram	3	51	49	39
Nabam	3	62	24	13
Control		51	12	4
		Experiment 2[c]		
Thioneb	3	38	82	69
	1 1/2	42	43	31
	3/4	36	58	25
Thiram	3	46	82	81
	1 1/2	67	84	72
	3/4	23	84	52
Mesulfane	3	34	91	70
	1 1/2	40	82	50
	3/4	27	89	43
Norsulfane	3	30	90	70
	1 1/2	42	81	50
	3/4	28	68	43
Captan	6	40	65	37
Dichlone	3/4	28	86	82
Control		37	35	21

[a] Four replicates.

[b] Three replicates.

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TOLERANCE OF STRAWBERRY PLANTS TO HOT-WATER THERAPY

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SUMMARY

Strawberry plants dug when air temperatures were low and the plants were dormant and immersed immediately in water at 127° F withstood immersion for longer periods than plants dug in late fall or early spring.

Storage at 32° F for 2 weeks increased the hot-water tolerance of strawberry plants dug between early December and early March. Cold storage did not increase the hot-water tolerance of plants dug in late March after plant growth had started in the field.

Plants that were immersed in water at 127° F for 2 minutes survived best if the treatment was made at the end of cold storage when storage was at 32°.

Most of the 55 tested strawberry varieties were as tolerant as or more tolerant than the Blakemore variety to immersion in hot water. Cold-stored plants of Howard 17, Empire, and Jumbo were less tolerant than similar Blakemore plants.

Strawberry plants have been treated with hot water to inactivate viruses (2), to eradicate nematodes from the roots (1) and from the crowns and leaves (3), and to control cyclamen mites (4).

The tolerance of strawberry plants to hot-water treatments is apparently increased by dormancy. Miller (2) found that dormant plants usually withstood hot-water treatments better than vigorously growing ones. Goheen and McGrew (1) found that nondormant strawberry plants were killed easily while dormant plants from cold storage withstood immersion in hot water for a considerably longer period than necessary to eradicate endoparasitic root nematodes.

Since both normal winter cold and continuous storage at 32° F affect dormancy, the effect of these factors and their interrelation on the hot-water tolerance of Blakemore strawberry plants were investigated in experiments reported in this paper. To determine the optimum time to apply hot water therapy to cold-storage strawberry plants the effects of treatments at the beginning, midpoint, and end of storage were studied. Also, the hot-water tolerances of 55 other strawberry varieties were compared with the tolerance of Blakemore.

EFFECT OF NORMAL WINTER COLD

The hot-water tolerance of strawberry plants taken directly from the field at Beltsville, Maryland, was tested at weekly intervals from November 22, 1954, to April 4, 1955, except on January 31 and February 14, 1955, when the ground was frozen. Twenty-five plants of the Blakemore variety were dug each week. The old leaves were removed and the roots washed in cold water. The plants were separated into bundles of 5 each and individual bundles were immersed in water at 127° F for 1, 2, 4 or 7 minutes and then cooled in cold tap water. The fifth bundle was kept as a check. Immediately after treatment each bundle of 5 plants was planted in a 6-inch pot and held on the greenhouse bench until the full effects of the treatments were evident. The 2-minute treatment is sufficient to rid plants of nematodes (1). The 4-7-minute treatments were included to determine the maximum tolerance.

In the check lots all plants survived. In the immersed lots survivors were counted and a hot-water-tolerance index for the plants on each digging date was computed. This index is the sum of the products of survivors multiplied by time of immersion in minutes. For total survival when 5 plants were used at each of 1, 2, 4, and 7 minutes, this index would be 70; for no survival it would be 0.

The plants dug during periods when air temperatures were lowest were most tolerant to hot-water treatment (Table 1). The correlation coefficient between the hot-water-tolerance index and the mean temperature for the 72-hour period immediately before digging was -.83, which is highly significant statistically. On November 22, 1954 and April 4, 1955, no plants survived immersion for more than 2 minutes; but on February 7, 1955, 3 of 5 plants survived

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FIGURE 1. Surviving strawberry plants, on May 16, 1955, of 5 originally set in each 6-inch pot with the following conditions: top row, no hot-water immersion; 2nd row, immersion in water at 127° F for 2 minutes; 3rd row, similar immersion for 4 minutes; bottom row, similar immersion for 7 minutes. Left column, plants dug and immersed November 22, 1954; middle column, plants dug and immersed February 7, 1955; right column, plants dug and immersed April 4, 1955.

Table 1. Hot-water tolerance of Blakemore strawberry plants in relation to mean winter air temperatures

Digging date	Hot-water-tolerance index[a]	Mean air temperature (°F.) during 72-hour period immediately before digging
1954		
November 22	7	57
November 29	14	36
December 6	23	29
December 13	21	35
December 20	19	37
December 27	31	36
1955		
January 3	18	38
January 10	18	36
January 17	20	32
January 24	17	28
February 7	41	18
February 21	30	34
February 28	27	35
March 7	5	48
March 14	6	54
March 21	13	38
March 28	9	43
April 4	7	51

[a]Index equals the sum of products of surviving plants times number of minutes of immersion at 127° F. Each index value is based on survivors from 5 plants at each of 4 immersion periods (1, 2, 4, and 7 minutes). Maximum possible rating is 70.

for 4 minutes and 2 of 5 plants for 7 minutes (Fig. 1).

EFFECT OF STORAGE AT 32° F.

The hot-water tolerance of plants held in storage at 32° F was tested as described herein. Blakemore strawberry plants were dug on four different dates during the dormant season, namely December 2, January 4, February 10, and March 3, from adjacent rows in a commercial strawberry field near Salisbury, Maryland. The old leaves were removed and the roots cleaned. Twenty-five plants from each lot were used immediately and the remaining ones were placed in storage so that the experiment could be continued for 10 weeks or until the end of March. The 25 plants not stored were separated into bundles of 5 plants each and single bundles were immersed at 127° for periods tested in the previous experiment and the hot-water-tolerance index was calculated.

Table 2. Hot-water tolerance of Blakemore strawberry plants immediately after digging and after 2 weeks of storage at 32° F.

Source and digging date	Hot-water-tolerance index[a]	
	Immediately after digging	After 2 weeks at 32° storage
Salisbury		
December 2, 1954	37	42
1955		
January 4	23	42
February 10	23	37
March 3	24	35
Beltsville		
March 7	5	34
March 14	6	27
March 21	13	19
March 28	9	8
April 4	7	11

[a]Index determined as in Table 1. Maximum possible rating is 70.

At intervals of 1 week, 25 plants from each lot were removed from cold storage and the hot-water-tolerance indexes were obtained similarly. The hot-water tolerance of plants dug on any of the four dates was increased by storage at 32° for 2 weeks or longer (Table 2).

During March and early April 1955 the hot-water-tolerance indexes for Blakemore plants dug directly from the field at Beltsville (Table 2) were compared with those of plants dug from the field on the same date and held in 32° F storage for 2 weeks. Hot-water tolerance of plants dug on or before March 21 was increased by cold storage, but after that date plants in the field started to grow and cold storage had little or no effect on tolerance.

SURVIVAL OF STRAWBERRY PLANTS FOLLOWING HOT-WATER TREATMENT AT THE BEGINNING, MIDPOINT, AND END OF COLD STORAGE

The best time during the cold-storage period to treat strawberry plants with hot water to insure maximum survival was investigated. Blakemore plants for this experiment were obtained from the same source and on the same dates as plants for the first part of the previous experiment. From each of the 4 lots a series of 4 bundles of 5 plants each were set at intervals of 2 weeks from the date of digging until the end of March. One bundle of each bi-weekly series received no treatment other than a period of cold storage at 32° F; a second bundle was immersed in water at 127° for 2 minutes at the beginning of the cold storage period; a third was removed at the midpoint of the cold storage period, immersed in water at 127° for 2 minutes, dried and returned to cold storage for the remainder of the period; and a fourth was removed at the end of the cold storage period, immersed in water at 127° for 2 minutes and set immediately. During cold storage each bundle was kept in an individual polyethylene bag.

Ninety-eight percent of the untreated plants, 40 percent of the plants heat-treated at the beginning of storage, 89 percent of the plants heat-treated at the midpoint of storage, and 99

Table 3. Tolerance of strawberry varieties to hot-water immersion. (1955 experiments).

Variety	Hot-water-tolerance index[a]		
	Plants dug and immersed January 5	Plants held in 32° storage 2 weeks or more, immersed on indicated date: February 15	March 15
Blakemore	19	27	27
Aroma	27	27	
Dixieland	19	35	
Klonmore	22	27	
Midland	19	35	
Pocahontas	19	31	
Robinson	29	35	
Bellmar	15	29	
Catskill	17	31	
Massey	16	35	
Missionary	17	35	
Tennessee Beauty	14	27	
Tennessee Shipper	16	35	
Howard 17 (USDA virus-free)	13	25	
Albritton	25		
Armore	19		
Climax (Auchincruive)	19		
Dunlap	19		
Fairfax	26		
Florida 90	35		
Gem	19		
Klondike	31		
Konvoy	23		
Marian Bell	19		
New York	31		
Parramos	19		
Redstar	27		
Royal Sovereign	27		
Sierra	19		
Sioux	35		
Sparkle	35		
Tahoe	19		
Vermilion	34		
William Belt	31		
Marshall	13		
Tennessean	16		
Ambrosia			35
Big Joe			35
British Sovereign			35
Crimson Flash			35
Dorsett			35
Fairland			35
Fairpeake			31
Mastodon			31
Plentiful			29
Polar Queen			29
Red Crop			35
Red Rich			35
Stelemaster			31
Streamliner			35
Superfection			35
Temple			35
20th Century			35
Wisconsin			214
Empire			23
Jumbo			15

[a] Index equals the sum of products of surviving plants times number of minutes of immersion at 127° F. (Each index value is based on survivors from 5 plants at each of 3 immersion periods (1, 2, and 4minutes). Maximum possible rating is 35.

percent of the plants heat-treated at the end of storage, survived when they were set. Best plant survival was obtained when heat therapy was applied at the end rather than at the beginning or midpoint of the 32° F storage period.

HOT-WATER TOLERANCE OF STRAWBERRY VARIETIES OTHER THAN BLAKEMORE

To compare the hot-water tolerances of other strawberry varieties with the tolerance of Blakemore, two tests were made. In the first test, hot-water-tolerance indexes for 36 varieties including Blakemore were determined on the basis of 20-plant samples dug from the field on January 5, 1955 and treated immediately. Bundles of 5 plants each of each variety were immersed in water at 127° F for 1, 2, and 4 minutes and a fourth bundle of each variety was used as a check. If all plants survived the maximum rating was 35. In the second test conducted in two parts on February 15 and March 1, 1955, indexes were determined for plants of 34 varieties including Blakemore, all of which had been in 32° storage for at least 2 weeks. Thirteen varieties exclusive of Blakemore were included in both tests, making the total varieties compared with Blakemore 55 (Table 3).

On the basis of the hot-water tolerance indexes, most of the 55 other varieties were as tolerant as or more tolerant than Blakemore to hot-water immersion. Fresh-dug and cold-stored plants of Howard 17 were less tolerant than those of Blakemore. Cold-stored plants of Empire and Jumbo were less tolerant than those of Blakemore. Most varieties that appeared less tolerant than Blakemore in the test on fresh-dug plants proved as tolerant as or more tolerant than Blakemore in the test on cold-stored plants. No plants of Marshall or Tennessean were available for the second test on cold-stored plants.

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ALTERNARIA LEAF SPOT OF GERANIUM

Donald E. Munnecke

Abstract

Geraniums growing in southern California fields during the winter are often severely affected with a leaf spot caused by Alternaria tenuis Neergaard. The symptoms of the disease are described, based upon observations of artificially and naturally produced infections. The symptoms produced by Alternaria tenuis are compared with those produced by Xanthomonas pelargonii (Brown) Starr & Burkholder.

Geraniums (Pelargonium hortorum Bailey) growing in southern California fields during the winter are often severely affected with a leaf spot caused by Alternaria tenuis Neergaard. Fields located within a mile of the ocean are more severely affected than those in more inland regions. Although economic losses due to Alternaria leaf spot are minor, the disease is important since it may be confused with the leaf spot stage of bacterial stem rot (Xanthomonas pelargonii [Brown] Starr & Burkholder), and plants may be unnecessarily rogued out by growers in the mistaken belief that the leaf spotting is due to the highly infectious bacterium.

An interesting point is the strikingly high prevalence and severity of the disease on healthy green leaves during the winter. The fact that the leaves are still green and apparently healthy does not reflect the real condition of the plant. Because of the prevailing low night temperatures they are not growing actively. Consequently, the fungus, which is a pronounced facultative parasite, has ample opportunity to become actively parasitic on the plants which are existing at a low metabolic level because of the low temperatures. In addition the foliage is apt to be wet for long periods of time because of the frequent rains and fogs which prevail during the winter. The lowered host resistance and favorable environmental conditions combine in the conversion of the usually benign saprophyte into an active, aggressive parasite of the leaves.

Although a recent index of plant diseases in the United States (8) has listed Alternaria sp. as being a secondary leaf spot of cosmopolitan occurrence, several European authors have considered it as being parasitic in their localities (2, 3, 4, 6, 7). The Europeans referred to the causal agent as Macrosporium pelargonii Ell. & Ev. which Neergaard (5) has combined into Alternaria tenuis Neergaard. It is the object of this paper to show that A. tenuis can be an active parasite on geranium and to describe the symptoms of the disease.

The symptoms of Alternaria leaf spot are quite variable. The spots are most prevalent on the undersides of the older leaves on the plant, but the uppermost young leaves may also be infected. The following description of the symptoms is based upon observations of natural and artificially produced infections on P. hortorum. Initially, the infection appears as a water-soaked area, less than 1 mm in diameter on the lower surface of the leaf. This may enlarge to necrotic areas 2-3 mm in diameter with slightly sunken centers which are much less evident on the upper leaf surface. When viewed by transmitted light they have a small brown center surrounded by a yellow diffuse band. These are the "pin heads" and they may enlarge further, or be confined to this size. Those which enlarge further grade in size up to large, irregular, necrotic areas, 6-10 mm in diameter. Some of these large spots may be localized and isolated and have several concentric rings of darker brown tissue surrounding a dark center. The fungus may occasionally sporulate while the leaves are still on the plant, but the most abundant sporulation occurs on fallen leaves. Often the spots coalesce and form very irregular necrotic spots, usually limited by the large veins of the leaf. The leaf blade does not wilt, however. Severe infestations may kill the leaf or cause considerable leaf fall. Dead leaves shrivel and blacken, and the fungus sporulates abundantly.

The symptoms differ from the leaf spot symptoms of X. pelargonii as follows: 1) Alternaria leaf spot is most prevalent on the older, lower leaves. 2) No leaf blade wilting is associated with Alternaria infection. 3) Only the leaves are affected; there is no stem rot as is often associated with bacterial leaf spot infections. 4) The spots are very irregular in size, varying in diameter from less than 1 mm to large irregular blotches up to 10 mm in size. Bacterial spots are rarely over 2 mm in diameter. 5) Concentric rings are sometimes produced in the larger spots.

Isolations were made from naturally infected leaves collected during the winter months of 1952 to 1956 from Santa Barbara, Los Angeles, and San Diego Counties. Alternaria tenuis was obtained invariably from the leaf spots. Single spore cultures were grown and healthy

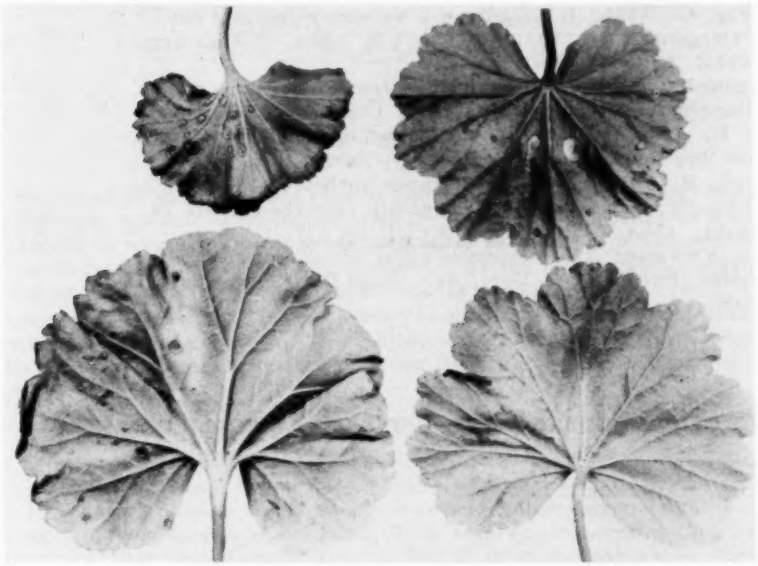

FIGURE 1. Leaf spot of Pelargonium hortorum var. Pride of Camden (left), var. Red Fiat (right), caused by Alternaria tenuis Neergaard. Note that the symptoms range from very small spots up to large coalescing areas.

geranium plants were inoculated by atomizing washed conidial suspensions over the leaves, incubated in a moist chamber for 24 hours, and then returned to the greenhouse bench. Three inoculations were made in 1952 and one in 1954, using fresh isolates each time. The symptoms produced by this means appeared within 1 week and were similar to the field symptoms (Fig. 1). No secondary spread was obtained in the greenhouse, although the plants were deliberately crowded on the bench and syringed twice daily. Eventually, the affected leaves dropped and subsequent growth of the plant was normal. Sporulation of the fungus was rare on intact leaves, but was very common on fallen ones.

Microscopic examination was made of hand sections taken from the leaf spots. Very limited mycelial growth was observed. Apparently the fungus penetrated and infected the leaf, but the mycelium then died and disintegrated, leaving the small circular dead spots in its wake. This may explain the lack of secondary spread in the greenhouse, as well as the sparse sporulation while the leaves remained attached to the plant. These findings of the behavior of the fungus during early stages of parasitism are similar to those of Bald (1) with Pleospora sp. on gladioli.

On the basis of the experiments reported here and the experiences of European authors (2, 3, 4, 6, 7), Alternaria tenuis Neergaard should be recognized as being capable of aggressive pathogenicity on geranium, Pelargonium hortorum.

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DEPARTMENT OF PLANT PATHOLOGY, UNIVERSITY OF CALIFORNIA, LOS ANGELES 24

EXPERIMENTAL TRANSMISSION OF ENDOCONIDIOPHORA FAGACEARUM BY COLLEMBOLA[1]

E. A. Curl[1]

Summary

The results of greenhouse tests showed that springtails (Collembola) can carry spores of Endoconidiophora fagacearum on their bodies from a source of conidia or a source of conidia plus ascospores to wounds on healthy oak seedlings, resulting in infection and death of the trees. Transmission of the fungus was obtained when the insects were caged on healthy trees within a few minutes after they were taken from the inoculum source. When an interval of 16 hours elapsed between the time insects were removed from the inoculum source and the time they were caged, no trees wilted. The results obtained here, along with facts relating to the life cycle of the Collembola, indicate that these insects may be potential vectors of the oak wilt fungus.

During the past 3 years several workers (3, 5, 6, 8, 10) have shown experimentally that certain insects can transmit the oak wilt fungus, Endoconidiophora fagacearum Bretz, to healthy oaks, causing disease and death of the trees. Other experimental work has indicated that the fungus may be spread by squirrels (7) or even by air currents (2). The combined results of these and other experiments suggest that all of these agents may play a part in the perpetuation of the disease in nature, although one agent may be more efficient than the others.

Large numbers of the primitively wingless Collembola, or springtails, were seen on naturally occurring mycelial mats of E. fagacearum in Illinois (1) in each month from October 1952 through June 1953. Maynard (9), while studying the Collembola of New York State, observed that many of these insects occur under loose bark and in crevices of living trees, and that certain species may be found wherever sap flows from trees in the spring of the year. Further, he stated that most species of the Collembola are vegetarians, feeding on algae, fungi, and lichens extensively, and that spores of fungi as well as algae, bryophytes, and pteridophytes are frequently found in the guts of some species. Glick (4) collected specimens of Collembola in the upper air in Louisiana and Mexico during every month of the year except January and September, principally when the surface wind velocity was from 9 to 10 miles per hour. Twenty-six specimens representing 3 families and 7 genera were caught at altitudes up to 11,000 feet.

These facts prompted the writer to consider experimentally the possibility that members of the Collembola may serve as additional vectors for the spread of oak wilt.

METHODS

In the spring of 1954, springtails were collected from beneath the bark of oak-wilt killed trees in several localities in Illinois. Many of these insects were taken directly from mycelial mats of E. fagacearum. No attempt was made to differentiate between species collected. The insects were placed in vials with small pieces of wood and transported to the laboratory in an ice-cooled picnic box. In the laboratory, two kinds of inoculum were used, conidia alone and conidia plus ascospores. Conidium-producing mats were grown in the following manner. Pieces of oak wood measuring approximately 3 by 1 inch were placed on end in 30 ml of chestnut broth (50 g dried chestnut meats in 1 liter of water) in 4-oz bottles. The broth and wood were steam-sterilized and the broth was seeded with spores from a single-spore isolate of E. fagacearum. Incubation was at 25° C. When the fungus had covered the portions of wood protruding above the broth surface, the pieces of wood were removed from the bottles. Disks of the fungus mats were cut out with a large cork borer and transferred to the bottoms of small weighing dishes. The insects were then introduced, and the dishes were covered and kept in the dark at 22° for 24 hours. Ascospores were obtained by growing two strains of the fungus on chestnut agar medium. When ascospores had exuded from the perithecial necks, disks of the fungus were cut out and exposed to the insects as described above.

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Table 1. Transmission of Endoconidiophora fagacearum to potted seedling oaks by springtails (Collembola) caged on wounded trunks after exposure for 24 hours to 2 inocula.

Tree number	Date caged (1954)	Inoculum[a]	Number of insects per cage	Date tree wilted (1954)	Tree number	Date caged (1954)	Inoculum[a]	Number of insects per cage	Date tree wilted (1954)
1	April 6	C	10	April 25	16	May 10	C + A	10	--
2	" "	C	10	--	17	" "	C + A	6	--
3	April 10	C	10	--	18	" "	C + A	6	--
4	" "	C	15	--	19	" "	C + A	8	June 12
5	" "	C	10	April 28	20	" "	C + A	10	--
6	" "	C	10	" "	21	" "	O	5	--
7	" "	C	15	May 1	22	" "	O	8	--
8	" "	C	20	May 14	23	" "	O	10	--
9	" "	C	15	" "	24	" "	O	10	--
10	" "	C	15	--	25	" "	O	6	--
11	April 27	C + A	8	--	26	" "	O	5	--
12	" "	C + A	5	--	27	" "	O	5	--
13	May 10	C + A	5	--	28	" "	O	8	--
14	" "	C + A	4	--	29	" "	O	12	--
15	" "	C + A	5	--	30	" "	O	5	--

a C = Conidia; C + A = Conidia and ascospores; O = No inoculum (controls).

Small cages were made of light-weight plastic sheets 2 1/2 by 2 inches. The sheets were folded over and the edges sealed together with a hot scalpel to form tubes. A cut 3/4 inch long was made on either side of one end of each tube. The cut sides of the tube were then pulled around the trunk of a tree at the point of the wound and fastened securely together on the other side with a paper clip. All of the seedlings used were potted live oaks (Quercus virginiana Mill.). The wound on each tree consisted of a single slanted razor-cut into the wood on the lower part of the trunk.

The springtails to be caged were first shaken from the small dish, which contained the portion of mycelial mat, into a clean empty dish. They were then shaken from this dish into the wide end of a glass funnel and allowed to move of their own volition down the funnel neck and finally into the open end of the plastic cage. The unattached end of the cage was closed with another paper clip. The insects always moved quickly to the moist dark wounds. The springtails were never shaken directly from the mat disks into the cages because of the possibility of shaking spores into the wounds. Also, it was desired that the insects carry with them only those spores which still adhered to their bodies after their extremely active interval in the second dish and passage through the funnel. Some of the insects were caged as quickly as they could be transferred; this required about 10 minutes. Others were caged after an interval of 16 hours in the second dish free from the fungus mats. A total of 255 insects were caged on 33 trees. For controls, an additional 74 insects that had not been exposed to inoculum were caged on 10 other trees.

RESULTS

The results are presented in Table 1. The table represents only that part of the experiment in which the insects were caged within a few minutes after they were taken from the source of inoculum. Six of the 10 trees caged with insects from conidium-bearing mats wilted and died, while only 1 of the 10 trees caged with insects from mats bearing both conidia and ascospores wilted. All of these infected trees showed symptoms within 35 days after the caging was done.

No wilt occurred when an interval of 16 hours was allowed to elapse between the time insects were removed from the inoculum source and the time they were caged on trees.

DISCUSSION

The experimental results presented here show that members of the order Collembola can carry spores of Endoconidiophora fagacearum on their bodies for at least a short period of time and deposit them in wounds of living oaks, with wilting and death of the trees resulting. Whether some of the insects also carried spores internally was not determined. The failure of insects to transmit the disease after a 16-hour interval between removal from the inoculum source and the time of caging is not explained. However, this could have been due either to loss of viability of the spores or to loss of the spores themselves from the bodies of the highly active springtails. The habit of the Collembola to feed on fungi, their constant occurrence in large numbers on mycelial mats of E. fagacearum, the fact that they are air-borne, and their habit of seeking seclusion in crevices or wounds of living trees further indicate that these insects represent another group that might spread the oak wilt disease in nature.

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ISOLATIONS OF VERTICILLIUM ALBO-ATRUM FROM WOODY HOSTS IN ILLINOIS, 1945-1955

Arthur W. Engelhard and J. C. Carter

The first record of Verticillium wilt (Verticillium albo-atrum Reinke & Bert.) on a woody host in Illinois was made by L. R. Tehon in 1926 when a sugar maple (Acer saccharum Marsh.) in Gibson City, Ford County, was found to be infected. Since staff members of the Natural History Survey began an intensive study of tree diseases in Illinois in 1931, numerous hosts have been found to be infected with the pathogen. From 1931 to 1937 (1) V. albo-atrum was isolated from black maple (Acer nigrum Michx. f.), Norway maple (A. platanoides L.), Schwedler's maple (A. platanoides var. schwedleri Nichols.), red maple (A. rubrum L.), sugar maple (A. saccharum Marsh.), smoke tree (Cotinus coggygria Scop.), catalpa (Catalpa speciosa Warder), almond (Prunus amygdalus Batsch), smooth sumac (Rhus glabra L.), black locust (Robinia pseudo-acacia L.), wayfaring tree (Viburnum lantana L.) and American elm (Ulmus americana L.). Additional woody hosts, found in 1939 and 1940 (2), were yellowwood (Cladrastis lutea (Michx. f.) K. Koch), American linden (Tilia americana L.), and two forms of American elm (Ulmus americana L.), Littleford elm and Moline elm. From 1941 to 1944 (3) additional woody hosts were Japanese barberry (Berberis thunbergii DC.), trumpet creeper (Campsis radicans (L.) Seem.), redbud (Cercis canadensis L.), and Amur privet (Ligustrum amurense Carr.).

The present report on isolations of V. albo-atrum from woody hosts in Illinois covers the period 1945 through 1955 (Table 1). Apparently magnolia (Magnolia sp.), black gum (Nyssa sylvatica Marsh.), multiflora rose (Rosa multiflora Thunb.), Augustine ascending elm (a form of Ulmus americana L.), and Chinese elm (Ulmus parvifolia Jacq.) are new hosts of V. albo-atrum, as no previous records of these hosts could be found. Tulip tree (Liriodendron tulipifera L.) is another new host of V. albo-atrum although it has been reported as a host of V. dahliae Kleb in France (4). Goldenrain tree (Koelreuteria paniculata Laxm.) was reported previously as a host of V. albo-atrum for Italy (5) but not for the United States. English elm (Ulmus procera Salisb.) and slippery elm (U. rubra Muhl.) are new hosts of the pathogen in Illinois.

In August of 1955, a black gum, 6 inches d.b.h. and 25 feet tall, located on the University of Illinois campus at Urbana, had wilting leaves on a few branches in the west side of the crown. V. albo-atrum was isolated from diseased branches which were collected from the tree on two occasions in September. By October 21, the leaves in approximately 75 percent of the crown were dried or wilted, most of them without changing color (Figure 1). However, a few turned yellow prior to dying. The xylem of the infected branches was a chocolate brown color. In some areas the discoloration extended to the pith (Fig. 2).

The symptoms of Verticillium wilt on Augustine ascending, Chinese, English, and slippery elms were similar to those on American elm. Externally the trees showed sudden or rapid wilting of individual branches or of the whole plant and internally the wood showed characteristically fine brown streaking.

The goldenrain tree displayed wilting leaves and brown streaking in the previous year's springwood.

Verticillium albo-atrum was isolated from a wilting multiflora rose that showed brown streaking, typical of Verticillium wilt, in the infected stems.

The magnolia tree had a long strip of dead bark on one side of a branch. Underlying this bark and also under the adjacent living bark the xylem was grayish-brown in color. Twigs showed grayish-brown discoloration in one or more of the last three annual rings.

Two tulip trees located on the University of Illinois campus wilted in late June. Cankers were present in the bark on the lower part of the trunk of the tree that showed most extensive wilt, and the xylem was greenish-brown in color. The tree that showed the least wilt had no cankers on its trunk. However, greenish-brown discoloration appeared as streaks in the xylem.

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FIGURE 1. Black gum (Nyssa sylvatica Marsh.) with Verticillium wilt (Verticillium albo-atrum Reinke & Bert.) on the University of Illinois campus, Urbana, Illinois, 1955.

FIGURE 2. Chocolate brown discoloration in xylem of black gum (Nyssa sylvatica Marsh.) infected with Verticillium albo-atrum Reinke & Bert.

Table 1. Isolations of Verticillium albo-atrum Reinke & Bert. from woody hosts in Illinois, 1945-1955.

Host	Location	Number of Plants in Each Year										
	County	1945	1946	1947	1948	1949	1950	1951	1952	1953	1954	1955
Acer platanoides L. (Norway maple)	Champaign										1	
Acer platanoides var. schwedleri Nichols. (Schwedler's maple)	McLean				1							
Acer saccharum Marsh. (Sugar maple)	Champaign	1		3							1	
	Cook						1	1				
	Montgomery								1			
	Ogle							1				
	Peoria				1			1	1			
	Shelby						1					
	Winnebago			1								
	Woodford								1			
	Unknown								1			
Berberis thunbergii DC. (Japanese barberry)	Cook											1
	Pike				1							
Catalpa speciosa Warder (Catalpa)	Cook				1							
	DuPage						1					
	Edwards				1							
	Peoria											1
Cercis canadensis L. (Redbud)	Champaign				1			1				
Cotinus coggygria Scop. (Smoke tree)	Kane								1			
	Livingston							1				
Koelreuteria paniculata Loxm.[a] (Goldenrain tree)	Peoria				1							
Liriodendron tulipifera L.[a] (Tulip tree)	Champaign					1						
Magnolia sp.[a] (Magnolia)	Will							1				
Nyssa sylvatica Marsh.[a] (Black gum)	Champaign											1
Rhus glabra L. (Smooth sumac)	Champaign				1							
Rosa multiflora Thunb.[a] (Multiflora rose)	Champaign			1								
Tilia americana L. (American linden)	Cook								1			
Ulmus americana L. (American elm)	Brown			1								1
	Bureau											
	Champaign			1			1					
	Cook					1		7	1		2	80
	DeKalb											2
	Douglas							2				
	DuPage											11
	Fulton											1
	Kane										1	2
	Lake											3
	Mason											1
	McHenry							1				2
	McLean											1
	Peoria										1	1
	Schuyler											1
	St. Clair					1						1
	Warren			1								
	Will							1				4
(Augustine ascending elm)[a]	Cook											1
(Moline elm)	Cook							2				1
	DuPage				1							
	Will							1				
Ulmus parvifolia Jacq.[a] (Chinese elm)	Cook							1				
Ulmus procera Salisb.[a] (English elm)	Bureau											1
Ulmus rubra Muhl.[a] (Slippery elm)	Brown											1
	Cook							1				1
	Peoria											2
	Putnam											1
	Warren											1
Viburnum lantana L. (Wayfaring tree)	Champaign			1								
Total Isolations		1	0	9	9	3	4	21	7	0	6	123

[a] New records for Illinois.

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MANUSCRIPTS FOR THE PLANT DISEASE REPORTER

(See also PDR 35: 121-122; 36: 214, 494)

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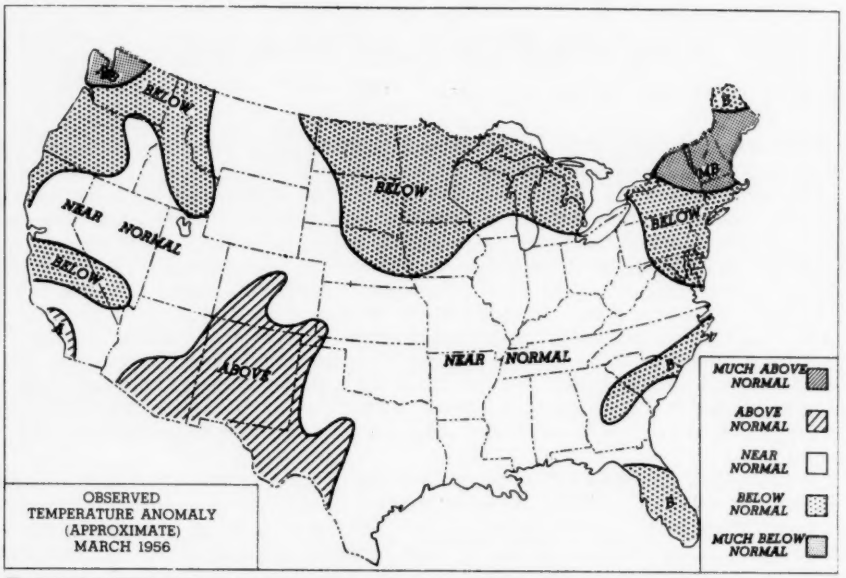

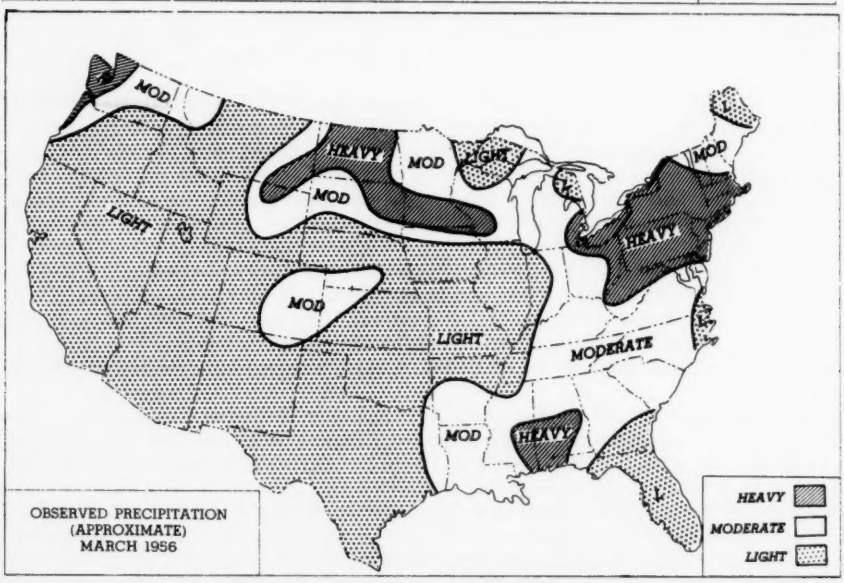

The terms used in the accompanying maps, which define the ranges of temperature and precipitation, are numerical class limits. These are based on a statistical analysis of past records through which is determined the normal frequency of occurrence of temperatures and precipitation at various times of the year for different locations. For temperature the classes above, below, and near normal are so defined that they each normally occur one-fourth of the time; much above and much below normal, one-eighth of the time Precipitation is depicted in terms of light, moderate, and heavy, each class normally occurring one-third of the time and thereby having equal probability of occurrence. These maps graphically represent only the general trends and give the country's weather picture at a glance. For quantitative studies, where monthly mean temperatures and actual precipitation records are needed for a given time and place, other publications of the Weather Bureau should be consulted. P. R. M.